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Forthcoming Events.

Institute of British Foundrymen.

MARCH 19.

Sheffield Branch:—Ordinary meeting at Sheffield. "Improving Cast Iron," Paper by J. R. Hyde.

MARCH 20.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. A lecture, entitled "A General Talk on Foundry Work," by Mr. Arnold Hodgkinson.

Scottish Branch:—Ordinary meeting at Glasgow. "Recent Developments in Cast Iron," Paper by J. G. Pearce.

Falkirk and District Section:—Discussion on "The Cupola."

East Midlands Branch:—Ordinary meeting at Leicester. "Foundry Practice in other Countries," Paper by F. Howe.

MARCH 23.

Wales and Monmouth Branch:—Ordinary meeting at Swansea. "Cupola Practice," Paper by J. J. McClelland.

MARCH 27.

Newcastle-on-Tyne Branch:—Ordinary meeting at Newcastle. "Notes on Loam Moulding," Paper by T. D. McDougal and R. Grigor.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

To Scrap or Not to Scrap.

In a recent journey to the North of England we were impressed by the untidiness of the yards of the various works which the train passed, and the thought continually crossed our mind that the works managers of these concerns ought to be censured. Primarily, it is a bad advertisement, and in some cases would be sufficient to prevent the placing of an order, for the casual traveller imagines that the interior of the shops is in a similar condition to the yards.

We are convinced that no works manager would willingly sanction an untidy yard, and reasons for their presence must exist. One of the chief reasons is that they are unable to decide as to whether a plant or heap of material may or may not be useful in the future. Another is that the mess may be the work of a predecessor, and it would cost money to clear away, which would adversely affect his working expenses. Again, it may be that the firm is so poor that it is unable to allocate any money for clearing up.

In the first case, if a manager is undecided as to whether a piece of plant or a heap of material may or may not be useful, he will be well advised to scrap, and by "scrap" we do not mean that it should be an additional memorial in the works graveyard, but sold and completely erased from the works books. If commercial conditions do arise when the scrapped plant could have been brought into commission, then the manager should be optimistic and content himself with the thought that a better plant has probably become available in the interim.

In the second case, where a manager objects to clearing up somebody else's mess, he must realise that such an attitude is indefensible, and so long as he holds a responsible position it is his duty to institute proper conditions. The influence that untidy yards and messy workshops have on the mentality of the workmen is profound. If there is insufficient money in the establishment to pay for the clearing up of a yard or shop, then our advice to the owners is to sell the buildings to the highest bidder amongst the second-hand dealers, and with the money so raised start anew in a *tidy* back yard.

It has so happened that our career has taken us into more works than is the lot of the majority of engineers and metallurgists, and we are satisfied that a general rule can be established that the greater the degree of tidiness in any one works the higher the rate of the dividend, and inversely the greater the untidiness the nearer are such concerns to the bankruptcy court.

It should not be understood that these remarks apply merely to foundries. Collieries, brick-yards, gas works, engineering establishments are equally culpable. If tidiness could only be graphed, we believe we could cite the case of a gas works, now prosperous, which for a period became shockingly untidy, and its long career of prosperity ended until the appointment of a new manager, when, as the works became more tidy, so did the prosperity of the concern return.

Suggestion for the Preparation of High Quality Grey Cast Iron.

Dr. F. Westhoff, writing in a recent number of "Die Giesserei," refers to the progress that has been made in the methods of producing pearlitic cast iron. The conditions necessary for success are mainly that the carbon content should be high, and the sum of carbon and silicon contents constant. The writer, however, regards the individual methods adopted for obtaining these conditions as troublesome and sometimes uncertain, and he suggests that existing processes be improved, especially as regards the reduction in carbon content, by mixing steel and cast iron.

During the war, when there was a shortage of spiegeleisen, attempts were made to recarburise steel produced in the small converter by adding to the converter grey cast iron from the cupola furnace. The fact that these experiments did not lead to a satisfactory result was due to the fact that the mixture did not remain sufficiently hot and fluid, owing to deoxidised steel having been used. If steel that is more or less oxidised be added to cast iron, we may assume that the reaction which sets in is sufficient to keep the temperature sufficiently high, and to ensure proper mixing. A steel of this kind has the added advantage of possessing a low carbon content.

Assuming that the temperature of the bath must be still further raised, the reaction could be carried out, say, in a gas- or oil-heated reverberatory furnace, which could also be used for further raising the temperature of the bath.

Assuming that cupola furnace iron contains, for instance, 3.3 per cent. carbon, and the steel practically no carbon at all, the carbon content would work out somewhat as follows:—

80 per cent grey cast iron...	3.30 per cent. C.
20 per cent. steel	0.00 per cent. C.
Total	2.64 per cent. C.

There would be no difficulty in keeping the silicon content and the percentage of the other constituents at the proper level.

The writer suggests that this idea be taken up by steel works (open-hearth, converter, or other works) which also have iron foundries. The quantities of steel required being comparatively small, it would pay ironfounders to install, say, a small open-hearth steel furnace for the purpose.

Another way would be to tap iron (grey cast iron) from a cupola furnace into a reverberatory furnace in which the necessary quantity of wrought iron had been pre-heated, and then raise the bath of iron to the necessary temperature.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

The Foundry Cupola.

To the Editor of The Foundry Trade Journal.

Sir,—I have read with considerable surprise the letter of Mr. J. Shaw in the Journal of March 11.

The temperatures quoted by Mr. Hurst, apart from the clerical error, appear to me to be correct.

Mr. Shaw suggests 1,330 deg. C. as the temperature attained in ordinary practice, but I am unable to accept that, in view of the fact that dead mild steel, having a melting point of 1,490 deg. C., can be easily melted in the cupola, and further if Mr. Shaw is correct how can he account for iron running from the furnace at 1,400-1,450 deg. C.?

I am also surprised that it should be stated "that no cupola lining would stand up to such a temperature." I recommend Mr. Shaw to look into the merits of a well-advertised plastic refractory now very extensively used, and which melts above Seger cone 39 (1,880 deg. C.).

I am, etc.,
A. Campion.

3, Strathview Gardens, Bearsden, by Glasgow.
March 12, 1926.

Association of Special Libraries and Information Bureaux.

A business meeting at which it is proposed formally to inaugurate the Association of Special Libraries and Information Bureaux will be held at the Institution of Mechanical Engineers, Storey's Gate, S.W.1, at 2.30 p.m., March 29, 1926. All interested are cordially invited to attend.

The Association is being formed to facilitate the co-ordination and systematic use of sources of information in science, industry, commerce, and public affairs generally; when fully developed it will function as a clearing house for those wishing to get into touch with specialised knowledge.

The Association's first activity is to be the compilation of a Directory of Special Libraries and Information Bureaux in the British Isles. No complete list exists at present, and the Directory should therefore prove a valuable book of reference; the work will be authoritative, and will indicate the sources where both scientific and non-scientific information may be obtained; the entries in the Directory are to be carefully annotated throughout. The whole movement is deeply indebted to the Carnegie United Kingdom Trustees, who, in addition to setting aside the sum of £1,500 to assist the Association in the first two years of its work, have now generously undertaken to defray the cost of compiling the Directory. It is anticipated that something like a year will be occupied in collecting the necessary data. Those in touch with special sources of information, and willing to collaborate with the Association in building up the Directory are asked to communicate with the Organising Secretary (38, Bloomsbury Square, W.C.1, from whom further information may be obtained.

German Pig-Iron Production in 1925.

In 1925 German pig-iron production reached 80 per cent. of its maximum possible capacity, assuming the latter to be 12 million tons. The industry has overcome the downward tendency caused by the occupation of the Ruhr. *Foundry* pig, on the other hand, is in a less satisfactory state, because whereas in 1913 the production was 2.6 million tons, it was only 1.3 million in 1925. Before the war foundry pig made up about 20 per cent. of the total pig-iron production, whereas the corresponding proportion in 1925 was only 13 per cent. It is strange to note that whereas the production of Bessemer pig, puddled iron and foundry pig show a downward tendency, steel-making iron, spiegeleisen and hematite pig-iron have all increased. The monthly production figures of foundry pig in 1925 also show remarkable fluctuations, which have a tendency that is independent of the production of pig-iron in general. "Die Giesserei," from which these figures and facts are taken, states that it cannot definitely be forecasted whether this and subsequent years will show an increase in the production of foundry pig.

Catalogue Received.

Flexible Shafts.—We have received from The Flexible Drive & Tool Company, 35, Bloomsbury Square, an advance copy of 24-page catalogue describing and illustrating innumerable uses for flexible shafts. In the main they are for use with portable tools and instruments. It often happens that when a machine is erected some hole requires to be drilled and a flexible drive is almost an essential. For grinding, too, there is a considerable field of application. In short, wherever conditions arise that it is preferable to bring the machine to the job, flexible shafts should be considered, and we believe that the catalogue under review should be procured by those whose duty it is to control such operations.

Mr. B. F. Sperring, managing director of W. H. Sperring & Company, Limited, Albion Iron Works and Foundry, Portsmouth, one of the first twenty to join the Institute of British Foundrymen, has just been elected president of the Portsmouth and District Engineering and Shipbuilding Employers' Association.

The Die-Casting of Aluminium Alloys: A Review of Current Methods.*

By George Mortimer, Member (Birmingham).

(*Continued from page* 190.)

Economical Considerations.

Economically the pressure system starts with a heavy advantage in speed, accuracy, and the possibility of running thinner sections than are practicable in a gravity mould. It is economical in labour because most of the operations are effected by mechanical means, and in metal because both gates and actual sections of the castings are cut to a degree impossible when working only with gravity.

These advantages, however, are not obtained for nothing. The whole proposition of pressure casting hangs on the handling of sufficient numbers of castings to one design to warrant a heavy initial outlay. Pressure-casting machines are costly items, and in addition to these must be added the capital cost of a well-equipped machine-shop on tool-room lines, for the production and maintenance of the necessary dies. These dies are in themselves exquisite pieces of mechanism, designed

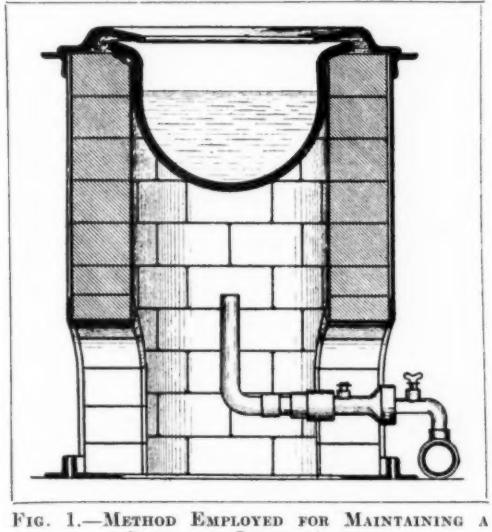

FIG. 1.—METHOD EMPLOYED FOR MAINTAINING A SUPPLY OF LIQUID ALLOY.

and constructed by experts, built up of sections and cores and slides of special alloy steels. These steels, selected with care by metallurgists, are heat-treated more than once in the process of manufacture, and tested again and again for minor flaws and cracks which, infinitesimal in themselves, may cancel much costly workmanship when subjected to the searching action of molten aluminium under pressure.

Against this the ordinary gravity-mould, cast in a close-grained grey iron, finished in any average machine-shop to dimensions given on a rough sketch, is a mere bagatelle. Such a mould often enough costs little more than a set of first-class mahogany patterns and core boxes; it may cost less than metal patterns and stripping plates arranged on a machine for an equivalent output in sand moulding.

There is, in fact, little room for comparison between the outlay on a gravity mould and that on the highly developed die of a pressure machine. The former is justified on orders for a few hundreds off. For the same casting a pressure-die would seldom be justified for orders of as many thousands, whilst the great pressure die-casting industries were in fact largely built up on orders running into the region of millions of castings from one fixed design.

It is mainly for this reason that we in this country, lacking the demand for castings in vast numbers to one design, have tended to develop the undoubted usefulness of the simple gravity mould; whilst Americans, with their immense internal markets and their genius for quantity production, have brought the process of pressure casting to a very high art. There are wireless and telephone parts, household and automobile fittings, required in this country in quantities which well justify the initial outlay on the pressure system. In few cases, however, do the quantities called for approach the numbers taken by the internal market of the United States, and the field, such as it is, would appear to be amply covered by the few firms in this country specialising in the process.

Pressure casting spells "overheads," not only in plant, but in much specialised and patiently acquired experience; for the mere purchase of an up-to-date machine is probably the smallest step towards the economical production of pressure castings. Gravity-casting is on the whole the more generally suited to the technical and economical requirements of industry in this country as at present constituted, and it is for this reason that the author offers the following hints on first principles to any who may be interested in its possibilities.

Gravity Casting Practice.

Equipment.—Let it be assumed that the necessary melting plant is available, on lines suitable for sand-casting. In addition to this, for convenience in working, it is desirable to provide some sort of plant for maintaining the metal in a molten condition, handy for ladling into the mould. The simplest is seen in Fig. 1, and consists of a cylinder of sheet iron lined with refractory brick-work, and supporting a cast iron pot of about 100-lb. capacity, fired either by a Bunsen gas-burner or by fuel oil. Note that a cast iron cowl is provided, which deflects waste heat and a less oxidising atmosphere on to the surface of the melt. Such a furnace can be built on the spot in a short time at little outlay; its upkeep is negligible, and founders will doubtless provide their own refinements according to their own ideas and experience.

Secondly, one needs sooner or later some method for raising the dies to their working temperature of between 250 and 450 deg. C. A simple and economical expedient is to place the die on the top of the furnace; and, generally speaking, when the die can be worked rapidly and smoothly it is maintained automatically at its working temperature by the molten metal. As experience is gained, however, larger and larger dies come into commission, and it is as well to provide at the outset some form of muffle for preheating them. For the same reason it is well to design this muffle so that its floor rests on or near the floor of the shop. A hot and heavy die is an awkward object to remove from a high muffle, and in addition the resting of the muffle on the ground prevents some loss of heat through free circulation of air beneath it. A simple form is merely a brick chamber reinforced by angle iron framework, and fired by a couple of gas or liquid fuel jets. This muffle can obviously be designed and erected by any intelligent bricklayer, directed by a foreman who knows what he wants, and it is likely to save a great deal of time in getting the dies under way in the morning.

Thirdly, one needs a cast-iron table or two on which to manipulate the dies.

Fourthly, some suitable ladles, skimmers, a lead or copper hammer or two, and a few pairs of tongs. All ladles, skimmers, pots and other gear likely to come in contact with the molten alloy must be periodically cleaned and kept dressed with a whiting and water-glass wash (Fig. 2). A large universal vice or two are useful, fixed to a handy bench, for carrying out those small die adjustments and easing of parts best done on the spot.

Dressing and finishing is also best carried out

D

* A Paper read before the Spring Meeting of the Institute of Metals. (Slightly abridged.)

close at hand, so that runners and risers may go back into the pots with a due proportion of new metal, and with the smallest proportion of dirt. For this a small bandsaw is strongly recommended as clean and rapid, and a disc grinder or a "Linisher" is a useful accessory for final touches.

Good ventilation, racks for spare dies, trays for skimmings and spillings, make for clean and efficient work. The die-casting process is essentially one of cleaner surroundings than are possible in the sand foundry, and development of this aspect has a sound moral effect.

Material for Dies.

The best all-round material at present available is a good cylinder iron having a close-grained structure and a degree of hardness which will not interfere with convenient machining and hand-cutting. Some authorities recommend an iron fairly high in phosphorus, on account of its fluidity and the clean definition obtainable. It is, however, a moot point whether this advantage may not be offset by the greater liability of phosphorus-bearing irons to attack by molten aluminium. One of the many analyses known to serve the purpose well is given herewith:—Graphitic carbon, 2.90; combined carbon, 0.40; silicon, 1.50; phosphorus, 0.50; sulphur, 0.05, and manganese, 0.9 per cent.

The actual amount of material to be used is difficult to outline, hinging as it does on the individual problems to be met on different castings. A useful rule is to allow for the walls of the die a thickness in the ratio of 3:1, to the thickness of aluminium alloy it is moulding. This is about the best ratio of chill to obtain the best metallurgical results from the alloys mentioned, and although the rule cannot often be followed logically throughout the mould, it is a good basis upon which to start. Allow more iron in the gates than would appear strictly necessary. Die-castings are sensitive to gate design, and it is useful to be in a position to carry out slight changes in gate section or contour as found desirable.

Design of Dies.

It is outside the scope of this Paper to deal very exhaustively with so wide and complicated a subject as die design. The problems to be met differ too greatly in both technical and economical directions, and the manner in which they are met depends so much on the training and previous experience of the die-maker.

There is, in fact, some solid comfort for the beginner in this very diversity of method. There is no particular standard practice in existence yet: a die in one street may turn out castings as rapidly and truly as a die in the next street may turn out the same casting, although the design and operation of the two dies may differ widely. In other words, a great deal hangs on personal ingenuity, common sense, and the gathering of experience on relatively simple work. None of these can be imparted by the most detailed treatise, but a few hints in regard to the mechanical and metallurgical requirements may assist matters.

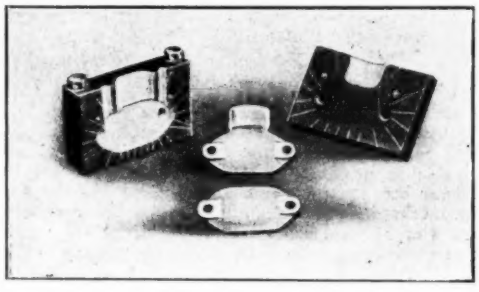

Fig. 3.—Mould Cut wholly in One Side of Parting Line in Vertical Plane.

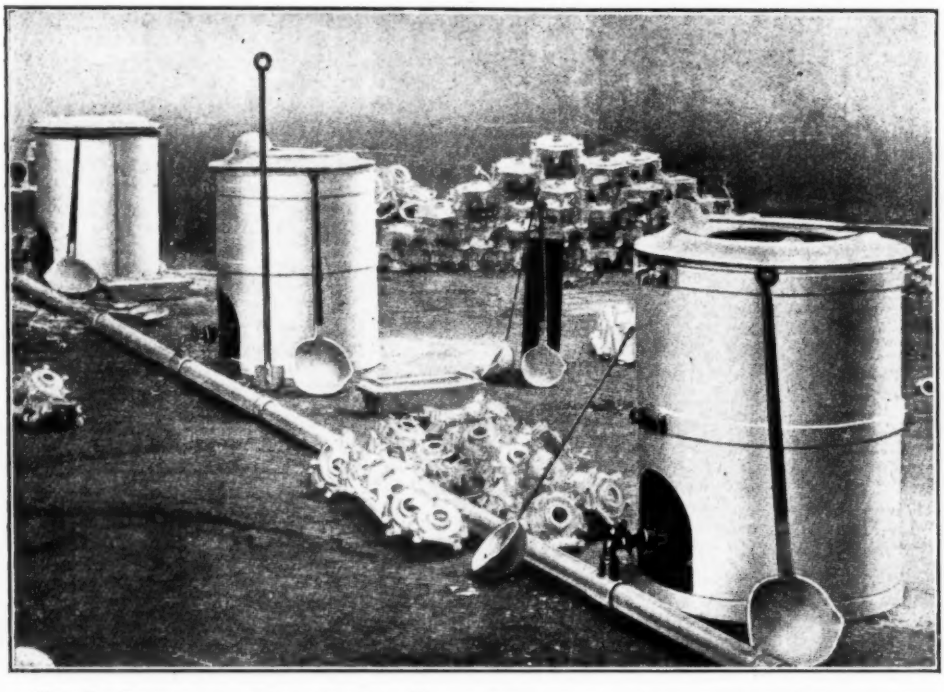

Fig. 2.—Section of a Small Gravity Mould Shop, showing Arrangement of Maintaining Furnaces, etc.

Mechanical Points in Design.—The point to keep in mind is that a casting is wanted, not only as sound as possible, but also as quickly as possible; that implies a casting which can be ejected from the mould with the minimum of trouble.

The first point to settle, then, is the line or lines on which the mould will be parted, and the parting line will generally fall into one of the four following classes: (*a*) Where the casting impression with its runners and risers may be cut wholly in one side of the die (Fig. 3); (*b*) where the casting is so symmetrical about its centre line that half of its impression and runner may be cut in each side of the die (Fig. 4); (*c*) where the dies are built up on a bedplate which may or may not mould part of the casting (Fig. 5); (*d*) where the impression is cut almost wholly in a bedplate, covered in by one or more runner blocks (Fig. 6).

Having fixed the parting line so that the casting

will obviously leave the mould without undue persuasion, there are two factors which should affect its final choice. The first is that parting lines leave a slight flash, so that they should be located if possible at corners where they will not spoil the look of the casting (Fig. 4). The second is that parting lines act very usefully as vents: the existence of a parting along the corner of a casting

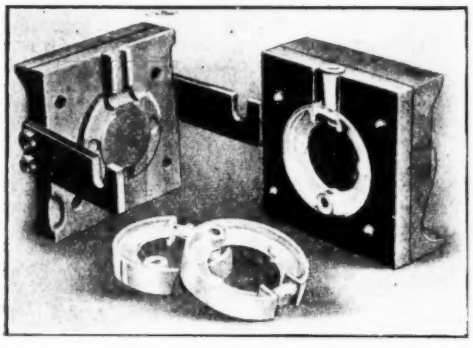

FIG. 4.—A CASTING SYMMETRICAL ABOUT ITS CENTRE LINE, AND CAPABLE OF BEING MOULDED SYMMETRICALLY ABOUT THAT LINE. DIE IS DIVIDED IN VERTICAL PLANE, BUT DELIBERATELY SUB-DIVIDED TO PROVIDE (A) SIMPLICITY IN ITS MANUFACTURE, (B) A PARTING LINE ROUND EACH EDGE, GIVING CLEAR DEFINITION, AND AVOIDING MARK OF PARTING LINE.

brings that corner up sharp and accurate (Fig. 4). For this reason alone extra partings in the die are often incorporated and bolted permanently up again. If there is any choice in the location of the essential parting line, place it along some corner which calls for sharp definition; it will then be converted from a blemish into a definite asset.

Finally, having fixed the parting line with due attention to the above considerations, there arises the question of subdivision from the point of view of easy construction alone. Many cases will be encountered where, by providing a further parting line which is afterwards bolted up, much arduous and costly hand work in undercutting is converted to a rapid and simple machining operation (Fig. 4).

Locking Devices.

It is necessary to lock the halves of a die very firmly together to avoid inaccuracy, and yet by some device which only takes seconds to release. A die which is being worked into condition may be gripped together by ordinary clamps: sooner or later it is well to provide some simple and more permanent locking device, such as is shown in Fig. 7. The curvature of the hook plates should be so arranged that a tap with a lead hammer on the top of the hook draws the two sides of the die hard up together. Refinements on this simple method will suggest themselves to a keen staff.

Ejector Pins.

These used to be a standard fitting, but by careful design they are as often omitted altogether nowadays. The objection to ejector pins, apart from the increased cost of the die and an unnecessary complication, lies in the fact that they inevitably leave their mark on the casting. For the great majority of castings nothing more should be needed for rapid extraction than a few taps with a lead hammer on the die whilst the casting is grasped by tongs at a gate or riser.

Dowels and Spigots.

It goes without saying that the different parts of a die must be located accurately in regard to one another, and that either spigots or dowel pins must be provided to this end. These must be given a slight taper, in the general cause of rapidity of working (Fig. 5).

Cores.

Cores are continually subjected to tensional stresses, and are further liable to rise in temperature, since they are generally for the most part surrounded by molten metal. They are therefore made of tool steel of the usual tungsten class. A slight taper is allowed on all cores, and similar parts withdrawn quickly to allow of contraction in the casting. Where, as in the case of automobile pistons, it is necessary to maintain parallel dimensions, cores are made up in three or more sections; the centre ones are provided with a large taper, and are withdrawn first, thus releasing the side sections (Fig. 8). Even where the internal dimensions do not call for great accuracy, it is often more economical in deep draws to divide the core in this manner, in the interests of rapid and easy operation.

Handles.

Into the sections of die and core steel rods of about $\frac{3}{8}$ in. in diameter are screwed and bent into the form of handles for convenient manipulation of the parts. On small dies worked at relatively low temperatures these may be fitted with ordinary wood file handles; on larger work the operators work with gloves, and wood handles are discarded.

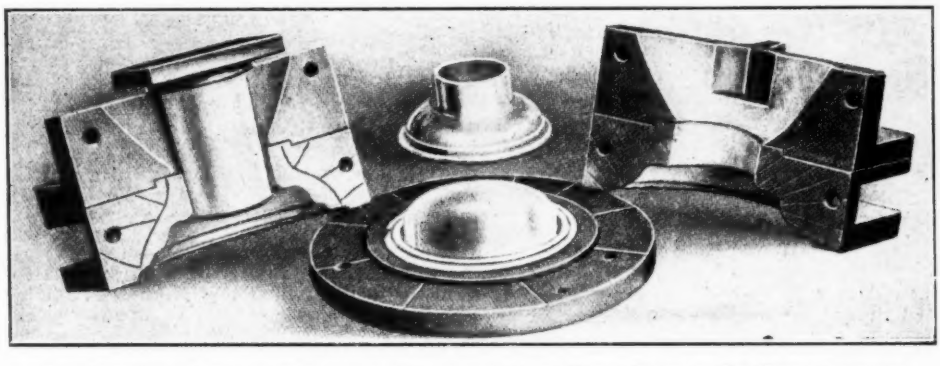

FIG. 5.—MOULD CUT IN HORIZONTAL PLANE, MOSTLY IN UPPER PLATE OF DIE BODY, SHOWING SPIGOTTED LOCATION OF THE VARIOUS PORTIONS OF THE DIE, GROOVES AND VENTING, CORE IN POSITION ON ONE SIDE. CASTING LOUD-SPEAKER HORN BASE.

Contraction Allowance.

Allow 0.1 per cent. for contraction in the design of the die, and correct any slight inaccuracies afterwards.

Refinements.

The above hints indicate only the main necessities. There are patent machines for opening up dies rapidly by various devices: some of the patent core-making machines on the market can readily be adapted to the purpose, and on a long running contract some apparatus of this sort generally comes into being as a natural development in the direction of saving seconds. As a general rule, however, the simpler the die to start with, the greater the chance both of technical success and of profit on the job. For the rest, a guarantee to the operators and charge hands that piece rates will not be cut throughout the run of a contract is often productive of much ingenuity in time-saving devices.

Metallurgical Aspects of Design.

No molten alloy abandons its idiosyncrasies because it happens to enter a metal mould as distinct from one in sand. The fascination of casting aluminium alloys in permanent moulds lies largely in the scope for personal common sense, in the overcoming of four cardinal obstacles: (1) Low density; (2) high crystallisation shrinkage; (3) high solid contraction, and (4) weakness at high temperature. Taking these factors in the above order, how do they affect die design?

Light Weight of Aluminium Alloys.

Under this first heading may be considered all difficulties met with in the effort to obtain clean, accurate definition.

Needless to say, where the metal or the die is too cold, or pouring is erratic and unduly prolonged, sharp definition cannot be expected. Where these points are entirely in order, however, it is still the commonest occurrence to find that some shoulder or corner, some lettering or an isolated boss, all cut sharply and accurately in the die, come out in the casting with an undesired radius. The cause of this is a cushion of entrapped air, which the low weight of the metal is unable to compress, and so the molten alloy never arrives at the corner at all. To overcome this venting is resorted to.

Venting.

The bulk of venting in a solid metal die is taken care of by the usual risers. Where a small casting is provided only with a gate, a common enough proceeding in small work, some provision must be made for the escape of air at high points. The usual vent is that indicated in the example shown in Fig. 9, and is simply a groove of about $\frac{1}{16}$ in. wide by $\frac{1}{32}$ to $\frac{1}{16}$ in. deep, cut across the surface of one side of the die.

This is the simplest instance, and cases may arise where it is not possible to take the air away *via* the face of the die; some may remain in a small recess which is not in the plane of the die surfaces. In these cases one or two very small holes are drilled to the most effective point through the die body. The surface tension of the alloy is sufficient to prevent molten metal entering these holes.

These steps take care of the bulk of escaping air. There remains the far more difficult problem of disposing of the minute air cushions that tend to lodge in corners and crannies, and to prevent the light metal from taking up the sharp definition of the die.

The simplest and most satisfactory method of obtaining sharp definition along edges of a casting is to arrange for that edge to coincide with the parting line of the die, and if this is impracticable, to arrange for a parting line which is afterwards permanently screwed up (Fig. 4). If again this is impracticable, one or two small holes as described above will help matters.

To render venting across the parting faces free, it is usual to cut radial grooves across the face with the edge of a half-round file (Figs. 3, 4, 5, 6). This is usually effective, but in some cases these grooves may be extended to about $\frac{1}{4}$ in. wide by 0.005 in. deep, and neither grooves are carried right to the edge of the casting impression. It is as effective and gives a far better finish to the casting if the venting grooves stop short of the casting by about $\frac{1}{32}$ in.

Although this is all that need be said about venting methods, it should be added that in the application of those methods lies the alpha and omega of clean-cut, accurate work. Very few castings turn out at the first attempt to the sharp cut lines of the die itself; all of them can be made to do so, in spite of the very low pressure available, by detailed attention to the venting of obscure recesses (Fig. 10).

Crystallisation Shrinkage.

Needless to say, no cores or sections can be removed before the metal solidifies. It follows that no amount of legerdemain will remove them before the shrinkage due to that solidification has taken place. This shrinkage on solidification is the cause of all draws, surface cracks, porosity, sinks, and a host of minor local blemishes.

Crystallisation shrinkage is always present, but its extent and its effect on the casting may be controlled by attention to two fundamental rules.

The first of these is to use as low a pouring temperature as possible. If misruns occur, it is better to raise the temperature of the die than that of the metal. This will tend to reduce the *total* shrinkage to be dealt with. The second is to aim at so filling the mould that the metal freezes progressively as it rises, drawing metal as it freezes from the still molten layer above.

Gating.

Since it is desirable to use cool metal, that metal must enter the mould with as little turbulence as possible, otherwise it will entangle air, and blowholes will show up on machining. Therefore it is usual to bring gates into the mould on a curve, and if the curve is found too steep in practice the mould may be progressively tilted as it fills. For this reason, until a die design is finally settled and in working order, it is better to have it loose on an iron table, not bolted to a stand or to an operating apparatus.

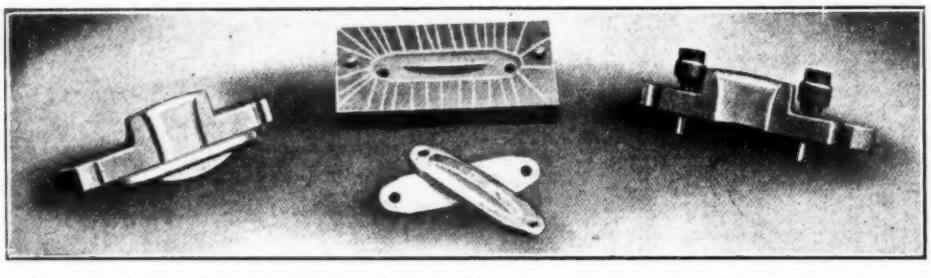

Fig. 6.—Simple Illustration of Casting Moulded entirely in a Bed-plate, Mould Divided in Horizontal Plane. Note Venting Grooves on Face.

The second rule is very much more difficult to apply to intricate castings, though easy and effective enough in the case of test-bars or rolling slabs. In the great majority of small, simple industrial parts, few of these refinements need be considered; the main thing is to fill the mould and to entrap as little air as possible in the process. The main problem consists in cutting the waste material in the gate to a minimum, and so most of such small parts are gated direct from the top; the results are good, and the gate is short.

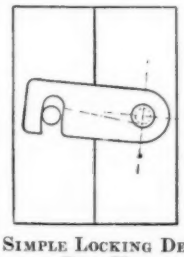

Fig. 7.—A Simple Locking Device which will pull the Two Halves of the Die up tight and is easily released.

Supposing, however, any tall and reasonably symmetrical example, such as a simple cylinder, is examined. To gate a casting of this height direct from the top will mean much turbulence, and it may also mean the formation of shots of solidified metal which are afterwards incorporated intact in the casting. It can be poured gently down one

side if the mould is progressively tilted, but only at the cost of making that side of the casting considerably hotter than the other, which does not lead to the soundest work.

Alternatively, it can be gated from the bottom, thus carrying all air up before the entering metal. If this is done in the case of a piston it will ensure that the bottom of the casting is still molten after the top has set—conditions which are emphatically to be avoided. If it is done on a casting of more varying section, the thin sections will set first, and the mould will be filled *via* the thicker sections; the latter will therefore be kept in a molten condition long after the thin sections have set, and considered gating aims at uniform solidification throughout.

The logical way to gate such a casting is to provide a runner connected by a slot with the mould for practically the whole of its height (Fig. 11). The metal can then enter the mould laterally as the level rises, solidify throughout more or less progressively, and feed as it solidifies on the rising molten layer above.

Now, if this is all confined to one side of the mould, we still have the drawback that that side of the mould is heated up at the expense of the far side, and so will tend to keep the casting on the runner side molten after the far side has set. To balance things it is usual to make a counterpart of the gate (a riser) on the opposite side of the casting.

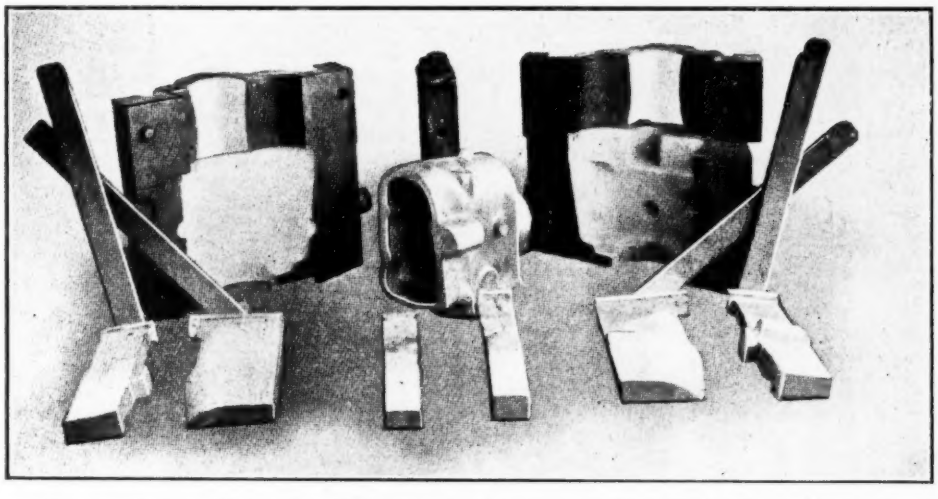

Fig. 8.—Simple Mould for Motor-Cycle Gearbox, showing Division of the Core and Mould.

Placing of Gates.

With regard to actual placing of gates there are two widely distinct schools of thought, both backed by sound reason. The first recommends that gates be placed on the thick sections, in order that these may be fed from the live metal in the gate. The second argues that the farther the metal has to go before it reaches thick sections, the cooler it will be when it gets there, and the less the necessity for feeding them.

Both systems work well in practice. The point to avoid is the adoption of some illogical position which is neither the one nor the other. If there is anything in favour of the one or the other system, it is that the second is the more likely to bring about that aim of ideal gating, the uniform solidification of the casting, and therefore a casting gated in this manner is the more likely to be free from internal stresses. Other factors have to be considered, however, such as removal of the gate afterwards, and its weight, and this and similar practical points will generally decide the matter.

Risers and Chills.

As in sand-casting, these palliatives for certain defects come up for consideration in connection with crystallisation shrinkage.

The first impression a visitor to a gravity-mould casting shop would gather is that risers are used to a very wide extent. This is, in fact, the case, but they are not used to anything like the extent seen in sand-casting for their primary purpose of feeding a thick section.

They are employed largely for such practical points as alternative gates, free exits of air and dross, free flow of live metal up to the limits of that part of the mould remote from the gate, equalisation of temperature between different sides of the mould. They are often attached to thin sections, so that these may not set before the thick ones. They are practically always so placed that removal by bandsaw is readily accomplished, and where bosses and heavy sections exist in positions beyond easy dressing, risers are omitted.

The reason for this is that in a chill mould, given careful pouring and direction of the stream by considered gating, the defects common to bosses and similar parts in a sand mould are seldom found. If sinks or draws occur, so much can be done by slight modifications to gating, or pouring, or relative temperatures, that these are invariably tried out before a riser is placed in such a position that rapid dressing is jeopardised. Where risers are essential for the plain purpose of feeding a section, the same rules laid down for sand-casting apply here; in fact, these rules are, if anything, emphasised because of the essential difficulty of designing a riser or shrinkage pad in a chill mould, in which the metal will not set before the section it is designed to feed.

Chills in a mould that is all chill may at first sight seem paradoxical. Chilling, however, is entirely relative, and a relative chilling effect may be obtained in at least two ways. The first is by inserting in the die construction local blocks of metal of higher thermal conductivity, and the second is by coating the die surface with any of the approved dressings and to omit to coat the part required to chill more quickly. Both are employed to a certain extent in very special circumstances. Generally, however, the expense of the one or the trouble of the other is not justified, in view of the wide range of relative chilling which can be brought about by a study of gating, pouring and the relative temperatures of mould, core and metal.

Solid Contraction.

Solidified metal contracting about a rigid core is necessarily stressed, and the remedy lies in the rapid removal of all cores or other obstructions in the path of the contraction. A slight taper on withdrawable cores and slides is allowed in the design to facilitate matters. The sooner they are removed after solidification the better, in the interests of the elongation figure obtainable in the finished casting.

Cores, being as often as not completely surrounded by molten metal, tend to gain in temperature. For this reason they are periodically quenched to a certain extent. If they are quenched in some such dressing as the following

they will be found easier to withdraw:—Plumbago, 9 lbs.; rouge, 3 lbs., and water, 5 galls. Keep this dressing reasonably well stirred.

The more easily cores can be withdrawn at the psychological moment, the less is the casting likely to be stressed through its solid contraction. For this reason, although both external and internal screw threads may be cast by this process with fair accuracy, the time factor should be taken into account before incorporating this feature in the design of the die.

The casting-in of bushes, inserts, magneto pole pieces, etc., is a valuable asset of this form of casting, and is becoming increasingly popular. From the founder's point of view they often eliminate many movable cores and simplify the die.

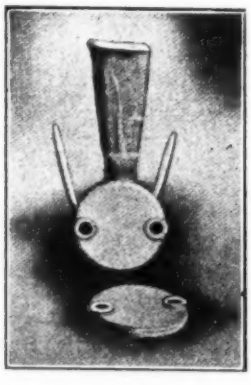

FIG. 9.—SIMPLE ILLUSTRATION OF VENTS AT HIGH POINTS WHERE NO RISERS ARE AVAILABLE TO CARRY OFF AIR WITHIN MOULD.

It should not be overlooked, however, that in these cases one is dealing with cores which are never removed, and that therefore the solid contraction is never released. For this reason this contraction should be cut as low as possible by the use of hot dies and cool metal, and by preheating the inserts to be cast in to a fairly high temperature, so that

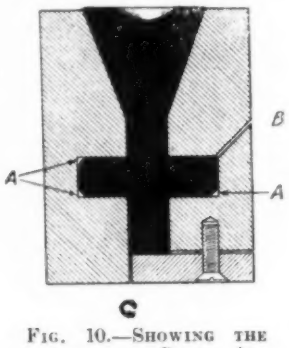

FIG. 10.—SHOWING THE EFFECT OF SMALL AIR CUSHIONS TRAPPED IN CORNERS ON THE DEFINITION, AND ALSO ITS PREVENTION BY DRILLING VENTS (B) OR PROVIDING PARTING LINES (C).

the relative contraction between them and the cooling metal is kept as low as possible. In addition, allow as much metal around such inserts as the design will permit; the metal surrounding such bushes or inserts is subjected to severe stresses on cooling. The more metal there is to take these stresses, the less the liability to cracks. This point needs attention in advance, because wasters assume a greater significance when they incorporate bronze and steel bushes which someone has paid for, and for which someone must be paid to remove from the casting again.

Dressing of Dies.

The dressing of dies is not so important a matter as that of cores, and unless vast numbers are required from one somewhat costly die, it is unnecessary and troublesome. Occasionally, however, dressing the die overcomes some minor trouble of venting or shrinkage because of the porosity of the thin film of dressing and its lower thermal conductivity.

The most common form of dressing consists of whiting and water-glass, with perhaps a little plumbago. A good mix is as follows:—Whiting, 12 lbs.; plumbago, 1 lb., and water, 5 galls., with a little sodium silicate. Keep this mixture well stirred, and for the best finish apply with an Aerograph pistol.

The use of dressings arose primarily out of the solvent action of molten aluminium on iron, an action which in practice appears to be very slight indeed. It is seldom that a die does not retain its accuracy, at any rate until some part of it cracks and has to be replaced, and this whether the die is dressed or not. If the surface has been well finished, a better finished casting is generally obtainable from a die left as it is, without dressing. The question as to whether to dress the die or not, therefore, is best left to the discretion of the man on the job, based on his experience with the particular die he is working.

Weakness at High Temperature.

This is the factor which, combined with the last, accounts for most cracked castings. Strange as it may appear at first glance, however, it is less emphasised in permanent moulds than in sand-casting. The metal gives up its heat so rapidly in

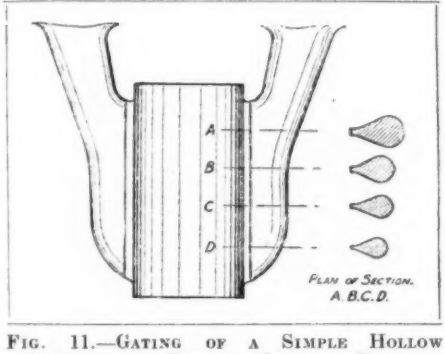

FIG. 11.—GATING OF A SIMPLE HOLLOW CYLINDER TO PROVIDE LATERAL FLOW OF METAL OVER SOLIDIFYING PORTIONS OF CASTING.

the metal mould that the normal period of "hot-shortness" is much curtailed. The zinc-bearing alloys are the worst offenders, but these are not in such wide use as the straight copper alloys for permanent mould work.

The chief point to watch is less one of design than of operation of the dies, that is, to avoid too great a hurry in removing the casting from the mould. The danger lies not so much in actual breakage of castings as in those minor distortions which are so much more difficult to detect in the casting shop, and which are so disastrous to that accuracy one is aiming at. The only point in actual design to consider applies to castings having flanges or other projections at the ends, and tending to grip the die when the metal contracts. Such castings must be removed before the metal contracts very far, and they must be removed easily or they will be damaged, because of their essentially tender condition. Therefore, wherever the provision of a loose piece in such cases is an uneconomical proposition, provide in the die a good taper so that the casting is liberated with a minimum of persuasion.

Quality of Work.

The gravity permanent mould process has suffered much in the past by its very simplicity. The fact that castings can be produced rapidly, economically and at very little initial outlay, has necessarily tended to the development of the quantity production side of the system, at some cost

to its undoubted potentialities in the direction of sheer quality.

Where small castings are required in great numbers at a large and steady output, it is difficult to compare gravity casting with the rapid work of a pressure machine under the supervision of an expert. The author has observed instances, however, where gravity dies costing hundreds of pounds have been made for certain aero-engine castings, the estimated output on which would hardly exceed a hundred castings per annum, and there are others where, for instance, a costly die has been made for a single order of ten pistons only for special Diesel engines. Such instances are only justified economically by the fact that a quality is obtainable at least approaching that of a drop forging, and certainly unobtainable at present by any other method of casting. This aspect is liable to be submerged in the general rush for quantities of castings at the lowest possible price.

Such quality is within reach of anyone prepared to apply first principles, and to keep in touch with their logical development through the invaluable work of the Research Associations. The author is acutely aware that this designedly simple review could have been more interesting, more directly constructive, had it included some of the recent findings of the Die-Casting Alloys Committee of the British Non-Ferrous Metals Research Association. These findings occasionally need interpretation into practical politics; but that again is possible through the melting pot of local metallurgical societies. Both are available to the small founder at an annual charge which would hardly keep a metallurgist in his foundry for a month.

Conclusion.

Finally, there is some encouragement for the beginner in two outstanding facts. The first is that, in spite of the rapid progress made in the technique and application of die-casting in the past ten years, no one system can as yet claim perfection, no single industry has yet been fully explored and exploited.

In the one case we await the results of research now proceeding on alloys and die materials, and a host of allied subjects of fundamental importance; maybe we await the advent of the machine which pours by gravity and applies great pressure immediately afterwards. In the second case much depends on the co-operation of those enlightened designers who, having experienced the technical and economical worth of die-castings, are prepared to risk substantial modification of some of their designs in order that these parts may be die-cast.

Crystal Growth in Recrystallised Cold-worked Metals.*

BY W. FEITKNECHT, Dr.Phil.

(*Summary.*)

The experiments described in this Paper deal with the changes of structure in cold-worked metals after recrystallisation is completed. They were mainly carried out with pure commercial aluminium (99.6 per cent.), but some work was also done with very pure aluminium (99.98 per cent.) and pure assay silver.

It is shown that, after recrystallisation was completed, all further changes of structure on prolonged annealing were due to the growth of existing crystals, both when the temperature was kept constant and when it was raised. No crystals were observed to start from new nuclei. No relation between the size and shape of the crystals and the capacity to grow could be detected. The growth was faster the more severely worked the sheets had been before recrystallisation.

The final size that the crystals reached after growth had come to a standstill increased with decreasing deformation. In the pure commercial aluminium, in the moderately worked samples, very large crystals were formed. Below a certain limit of deformation no considerable change took place after recrystallisation was completed.

A previous heat-treatment at a certain temperature had a considerable effect upon subsequent growth at another temperature and upon the final crystal size. In sheets thinner than 0.75 mm. the crystal size decreased with decreasing thickness of the samples, and in very thin sheets no considerable growth took place after recrystallisation was completed. In the very pure aluminium the growth was much quicker than in the pure commercial aluminium. The pure assay silver behaved much like the very pure aluminium, but the crystals did not grow so large.

An endeavour is made by the author to explain the observed facts by assuming that the crystals formed during recrystallisation were still strained, and that on heating further the least-strained crystals absorbed the crystals having the most remaining strain.

* A Paper presented to the Spring Meeting of the Institute of Metals.

The Interpretation of the Macrostructure of Cast Metals.*

BY R. GENDERS, M.Met.

(*Summary.*)

The interpretation of the structure of cast metals and alloys has depended mainly on empirical observation. While in the case of steel the macrostructural characteristics of a casting give definite information regarding casting conditions, the same indications cannot be applied directly to cast specimens of non-ferrous alloys, particularly to those consisting largely of copper, which solidify rapidly. The work described has the aim of establishing grounds upon which a more general interpretation of the macrostructure of metals, and consequent knowledge of the mechanism of the solidification of a casting, can be based. In copper alloys of high thermal conductivity, solidification occurs concurrently with pouring and the flow of metal within the mould becomes of primary importance in governing the mode of crystallisation. Experimental slab ingots 12 by 6 by 1 in. were made of two alloys of similar physical characteristics, but of different colour, melted in separate crucibles. By the use of a specially designed pouring-trough the metal passed into the mould in an unbroken stream, while the alloy comprising the stream could be changed at any prearranged stage by varying the amounts of metal in the two crucibles. The disposition of the colour zones distinguishable on sections from the ingots indicated that the process of formation of the ingot from the stream was one of continuous displacement of metal in the path of the stream to the faces of the mould. Several sets of casting condition, covering most of those used industrially, were included in the experimental work. The conclusions drawn concerning the mechanism of the formation of a casting permit of the interpretation of many peculiar features observed in the structures of ingots of copper alloys.

The effect on macrostructure of the temperature range over which the alloy solidifies is considered, and the theory accounting for the formation of equi-axed crystals by concentration variations in the region of the liquid-solid interface is developed and applied to a number of practical cases. In all metals having no freezing range, cast by ordinary methods, a completely columnar macrostructure is formed unless special precautions (which can be prescribed) are taken to avoid it. The method for determining the mode of formation of the casting by the use of two alloys is applicable industrially in connection with the design of moulds and casting methods.

* A Paper presented to the Spring Meeting of the Institute of Metals.

New South Wales Iron and Steel Industry.—It is likely that in the near future steel works costing about £2,000,000 will be constructed by the Hoskins Iron & Steel Company, Limited, at Port Kembla, New South Wales. An undertaking has been given by the Company to the New South Wales Government concerning the erection of the works, and it is unofficially stated that the Government will accept certain conditions laid down by Hoskins, Limited. The new works will provide employment for about 1,000 hands.

An Efficient Battery of Drying Stoves.

On a recent visit to the Holborn Foundry of Messrs. Smith & Company (South Shields), Limited, South Shields, our representative had an opportunity of inspecting the drying stoves which have recently been adapted for firing on the system of August's Muffle Furnaces, Limited, Halifax.

The drying plant consists of three stoves each 36 ft. long × 20 ft. wide × 12 ft. high, built as one battery; of these stoves two are set apart for drying propeller moulds, which are charged on special bogies, the bogies being fed into, and drawn out of, the stoves through chain and snatch blocks by the shop crane. The full charge for each stove is two moulds, but as the propellers run up to 19 ft. in dia. and weigh up to 14 tons, the drying is by no means a simple proposition. It may be noted the stoves take loam moulds up to 40 tons. The third stove is used for cores and general casting moulds.

A Battery of three August Drying Stoves at the Works of Messrs. Smith & Company (South Shields), Limited.

Formerly the whole of the stoves were wellfired, but even with the exercise of the greatest care it was impossible to get uniform results; there was always existing an amount of uncertainty as to whether the moulds would be dry when the time of drawing arrived.

It was the prospect of increased efficiency rather than the possibility of increased economy which led the management to decide upon the installation of the August's system; the results have more than fulfilled expectations. Mr. Smith remarked to our representative there was certainly nothing better, he doubted, indeed, if there was anything so good on the North-East Coast.

The three stoves are heated from one furnace; this furnace is 6 ft. high and has a grate area of 36 sq. ft. It is placed below stove floor level and housed in a pit, the entrance to which, as also the opening for the delivery of coke, are provided with covers. The primary air is admitted below the fire and the secondary air through adjustable dampers above the fire; secondary air is also admitted through damper-controlled flues in the side walls. The flues pass up the side and along the top of the furnace, at which last point they are admitted over the fire. This arrangement not only serves to keep down the temperature of the arching above the fire, but the heat exchange effected imparts a considerable degree of heat to the secondary air. The main flue which passes below the stoves is of diminishing area, proportioned so as to give practically the same heat in the distant as in the adjacent stove.

Air for combustion, both primary and secondary, is supplied under pressure from a Sirocco fan which is driven by a 4-h.p. motor.

The delivery main from this fan, provided with dampers for control of volume, is led into the roof of the furnace pit. Once the fire is started up, the covers are put on the openings of the pit and the whole of the air is delivered by the fan.

The hot air is admitted to the stoves through valve-controlled openings, six to each stove; the levers for operating these dampers are placed outside the stove. The gases, after circulation, pass into the main flue through openings which are controlled by a hand lever. Two of the stoves have floors depressed 20 in. for the full area, in order to carry off as quickly as possible the moisture driven out of the moulds by the descending gases, such moist air being carried off by the main flue; the spent gases are carried to atmosphere by a steel chimney with a brick base. The chimney is about 50 ft. high × 24 in. in dia.; obviously with forced draught the height of the stack need be no more than sufficient to carry the spent gases above the roof of the adjoining building.

With the stoves charged the furnace is blown for 2½ hrs. and then allowed to soak all night, and the moulds are always ready for drawing next morning. Obviously, unlike so many drying-stove installations which depend upon natural draught, the forced draught renders these stoves independent of atmospheric conditions. We are unable to give any figures regarding temperature, as such were not available, but, as Mr. Smith said, they can get much more heat than they want, and he summed up the matter by remarking they were now getting certain and uniform results, with 50 per cent. less coke, and an inferior coke at that, in about one-third the time of their old system.

Foundry Costing.*

By C. Dicken.

When considering the cost of production for any department in a large works, it is the usual practice to consult the general cost office for any particulars concerning costing and estimating, but experience has shown that the value of a "profit and loss" system worked in the foundry-office where queries can be immediately entered into and actual facts recorded. The cost of running such a system will be amply repaid by the economy which will result from the knowledge obtained. There are numerous ways in every foundry where waste, leakage, etc., may take place, and it is only by means of systematic records being regularly kept that these can be detected and subsequently avoided. A sound system is important for expense control, when the factors which are causing expense can be localised it becomes possible to introduce some plan to assist in reducing unnecessary expense. One of the objects of a good costing system should be a guide to estimating for future orders.

It is not the intention to criticise other methods of costing, but the author has noticed in THE FOUNDRY TRADE JOURNAL recently an article referring to Foundry Costs in reply to a Paper on economies. The writer gave as an example castings weighing from 28 lbs. to 56 lbs. at 26s. 5d. per cwt., and from 3½ to 4½ cwts. at 14s. 8d. per cwt. These are instances of hand-moulded general work, but if castings of a similar weight were plate moulded the price would be 16s. 4d. and 10s. 7d. per cwt. respectively. The writer then quoted prices of loam moulding, and further states that the above prices were obtainable at a glance.

It is doubtful if this system of costing by weight only would prove successful in an automobile foundry. For instance, it would not be correct to charge a side-by-side valve cylinder head at the same price as an overhead valve cylinder head. The weight of each may agree, but the first casting generally has one core, and the second has two jacket cores and a pipe core. The type, and therefore the amount of labour expended, must be taken into account or the whole cost is wrong. In one case the selling price of a certain article was £5 10s., whereas a competitive firm was selling at £4 10s. The cost of labour was 14s. 7d., so that without considering the cost of labour at all the price was too high. Obviously something was at fault in the method of costing, which emphasises the necessity of careful detail in all records.

The system which is to be outlined can be used in either ferrous or non-ferrous foundries, but it is chiefly concerned with the cost of production in a cast iron foundry from the arrival of the pattern into the foundry to the delivery of the rough castings to stores. Each process should be classified as a separate department such as "Metal melted," "Cost of melting," "Cores and moulds," "Pressing, Inspection and Despatch." The financial accounts can be so arranged that a portion can be charged to each department separately, and can therefore provide an ultimate cost of either casting or a cost for any particular process.

Time sheets must be made out correctly, each employee to state the exact number of hours spent on each class of work, so that the wages can be abstracted, and charged to each process.

Date:—

CAST IRON.

METAL MELTED.

Brand of pig iron.	Amount used.	Price per ton.	Total cost.	Metal produced.	Average cost per ton.
	T. c. qr. lbs.	£ s. d.	£ s. d.	T. c. qr. lbs.	£ s. d.
Northampton					
Cleveland					
Cumberland					
Scrap (bought out)					
Scrap (Foundry)					
Totals					

CHART I.

Date:—

CAST IRON.

MELTING COST.

Items.	Amount used.	Price.	Cost of Items.	Weight of good castings.	Average cost per ton.
	T. c. qr. lbs.	£ s. d.	£ s. d.	T. c. qr. lbs.	£ s. d.
Fuel					
,, ...					
,, ...					
Limestone					
Ganister					
Clay					
Fire bricks					
Flax					
Repairs					
Power					
Lighting					
Depreciation					
Sundries					
Wages					
Totals					

CHART II.

In one case the author had commenced duties in a foundry supplying castings to outside firms. The prices had been estimated previously, but when the pattern arrived the moulder would not accept the price, and a youth was allowed to assist him. This youth's wages would be entered as day-work, although it was really production, and would, of course, be a loss to the firm.

In other cases piece-workers were allowed an amount of day-work, and it was only by a careful scrutiny of the wages sheets that these mis-

* A Paper read before Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, Mr. D. H. Wood presiding.

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representations would be revealed. The foundry office should be regularly notified of fluctuations in prices of material, plus cartage (if charged separately). Careful records of all material used must be submitted to the office weekly, Sundries withdrawn from stores must be charged to the proper process or department. Work done by other departments, such as millwrights, etc., must be noted and the cost of material and labour obtained. These records may sound elaborate,

Workman's Order.

CAST IRON. Order No.
Date:—

Pattern No.
No required.
Process.
Piece-work price.
Metal.

No. made.	M.	T.	W.	T.	F.	S.

Cause of Scrap.

Foreman's signature.

Chart IIa.

but the system is installed, and each department accounts for its own consumption of material and other particulars; the whole thing works smoothly.

Metal Melted.

In the first place there is the cost of the cupolas or "Metal melted." This is set out in Chart I. It is important, not only from an analysis point of view, but also for careful costing that the weight of iron used, and the particular brand used each day, should be recorded, and the weekly amount submitted to the foundry office. Each brand of pig-iron can be thus charged at the correct price per ton. Bought out scrap would be treated in the same manner, but "foundry scrap," that is runners and scrap castings, etc., should be charged at the average price of "Metal produced" obtained by working out the total cost of "Iron melted" and dividing by the weight of "Metal produced." It should be remembered that there is always a loss in melting, and to be on the safe side it is wise to consider that only 96 per cent. of metal melted is produced, so that the average price per ton would be slightly higher to cover the loss in melting. The figure per ton arrived at is the correct price at which scrap castings, runners, etc., should be charged to the credit of the foundry. This is a useful figure, as it is most helpful for estimating purposes.

Melting Costs.

Different types of castings may require a more or less expensive pig-iron or the price of moulding and coremaking may differ, but the cost of melting in each case is the same per ton. It is necessary to obtain the weights used of such products as coke, ganister, clay, etc., in fact everything which is used in the process of melting, should be charged at the right price, always allowing a loss in coke. Wages abstracted from the time sheets for furnace men and labourers. Repairs to cupolas would be charged to the cost of melting. Electrician's wages should be noted and charged accordingly. Depreciation must be taken into account, and a small charge made weekly to cover wear and tear. A portion of charge-hand's wages must be allowed for supervision. A list of sundries, such as shovels, etc., should be obtained from the stores and charged to the cost of melting. To obtain the cost per ton of melting is an easy matter with the whole of the costs on one sheet. Divide the total by the weight of good castings. In this case the weight of good castings is used and not the metal produced, because it has cost the total to produce the good castings. The bad castings are only the value of scrap. A cost sheet illustrating the above is shown in Chart II.

Date:—

CAST IRON.

Cores and Moulds.

Items.	Amount used.	Price.	Cost of Items.	Weight of good castings.	Cost per ton.
	T. c. qr. lbs.	£ s. d.	£ s. d.	T. c. qr. lbs.	£ s. d.
Sand (red)					
,, (sea)					
Core gum					
Wax wire					
Sprigs					
Chaplets					
Coal dust					
Plumbago					
Repairs					
Patterns					
M'ld boxes					
,, machines					
Coal					
Gas					
Lighting					
Depreciation					
Sundries					
Wages					
Core-Makers					
,, ...					
,, ...					
Moulders					
,, ...					
,, ...					
Totals					

Chart III.

Cores and Moulds

This department does not require a great deal of material, but as in other departments care must be taken to insure every item being charged. It would be unnecessary for all sand to be weighed, but it is quite possible to account for the amount used either by taking the weight of a barrowful and calculating the number used weekly, or by taking note of the length of time a delivery lasts, and charging an average per week. Fuel for cores stoves, coal dust, plumbago, etc., may be calcu-

lated in the same way. Wax wire, tools, chaplets, etc., are usually kept in a foundry store, and it is a good practice to arrange for someone to be present for a short time each morning to issue materials required. In this way a record is kept which is useful for costing purposes and is also a guide to the existing stock. It is essential that core gum and core compound be measured to obtain the correct mixing of sand, so that it is easily possible for the sand-mixer to record the amount used. Cost of repairs to patterns can be taken from the pattern-maker's time sheets. Lighting and other items which are used generally may to shafting, engine, and power costs must be recorded. Wages may be abstracted under two headings, *i.e.*, dressers and labourers, and an amount of charge-hands' wages. A cost for lighting should be added. Sundries should be charged in the same way as other departments. The total of these figures will represent the cost of dressing.

Chart IV illustrates a method of setting out a cost sheet of the above items.

Inspection and Despatch.

This, of course, is a small department, with comparatively little cost attached except wages,

Date:—

CAST IRON.

DRESSING SHOP.

Items.	Amount used.	Price.	Cost of items.	Weight of castings dressed.	Cost per ton.
	T. c. qr. lbs.	£ s. d.	£ s. d.	T. c. qr. lbs.	£ s. d.
Emery wheels					
Saws					
Files					
Repairs to:—					
Shafting					
Power					
Lighting					
Depreciation					
Wages					
,, ...					
Totals					

INSPECTION AND DESPATCH.

Items.	Cost.	Weight of good castings.
	£ s. d.	T. c. qr. lbs.
Wages		
Sundries		
Totals		

CHART IV.

be charged to the right department on the basis of weight. Wages must be abstracted with every care. The type of casting must decide heading for the amounts. Intricate castings would be charged separately to ordinary castings, so that the additional cost may be taken into consideration for estimating purposes. The core-maker and moulder should receive an order for the number required. A duplicate of this order filled in by the man who receives the cores and castings must be returned to the foundry office weekly, and the quantity stated as received should agree with the number paid for, except in cases of scrap.

which of course would be considered as dead labour. It is important that the inspection and despatch should be worked by system with careful records so that all castings inspected can be traced whether good castings or scrap. The returns from this department should then record the correct weight of good castings produced.

Summary.

We now have the cost of each process from the arrival of the pattern to the despatch of the castings to the rough stores. The total expenditure taken from each sheet and added together repre-

Date:—

CAST IRON.

SUMMARY.

Process.	Total cost.	Weight of good castings.	Total cost per ton of good castings.
	£ s. d.	T. c. qr. lbs.	£ s. d.
Metal melted			
Cost of melting			
Cores and moulds			
Dressing			
Inspection and Despatch ...			
Overhead charges			
TOTAL			
Credit for Scrap			
TOTAL COST			

CHART V.

These records, which can be set out as shown in Chart III, prove useful when abstracting the time sheets.

Dressing Shop.

In some cases it is possible to fix a piece-work price for dressing castings, but in case of either day-work or piece-work rates it is important that the weight is carefully recorded. Castings broken in transit or spoiled in dressing must also be reported, as these all tend to increase the cost of production. Cost of emery wheels, saws, files, etc., must be charged to the cost of dressing. Repairs

sents the cost of production. The weight of scrap castings, runners, etc., to be credited to the foundry would be the difference between the weight of good castings and the weight of metal produced, to be charged at the average cost per ton of "metal produced." There is still the question of overhead charges to be added. This would be decided by each particular firm taking into consideration rates and other charges. If this figure is decided by a percentage, the charges for bought out material should be dealt with separately. The weight of good castings divided into the grand

XUM

total will give the exact cost per ton. The selling price of the castings compared with this figure reveal either a profit or loss. The system may seem to you elaborate, and perhaps a big task, but it can be worked by one competent clerk. The particulars obtainable at a glance are of great value. The cost of any particular casting can be arrived at very quickly by taking the cost of moulding and core-making separately, and charging each process accordingly. The cost is in every case an actual cost, and not guess work or a presumed estimate. The system should be worked out weekly, but an average cost monthly or quarterly is more likely to present a more definite figure, as there are so many reasons in a foundry which would account for fluctuation in output. The setting out of a cost sheet summarising all the costs is shown in Chart V.

The Duff Self-Lowering Jack.

A useful design of self-lowering governor-controlled jack has been introduced by the Consolidated Pneumatic Tool Company, Limited, Egyptian House, 170, Piccadilly, London, W.1. This jack, which is shown in the annexed illustration, has a drop-forged steel top, and an oversized key prevents the standard from turning, and keeps the jack from screwing out from under

THE DUFF GOVERNOR-CONTROLLED LIFTING JACK.

the load. A triple-pawl holding-clutch with three drop-forged, heat-treated steel pawls holds all the "raise" with each stroke.

The governor control assures absolute control of lowering speed, and eliminates all possibility of accidents through sudden or uneven dropping of load; the jack may be slowed down gradually or stopped instantly at any point without shock or any strain whatever on its mechanism. Uniform lowering is assured when two or more jacks are used under the same load. There is a three-position safety-type pawl "2" on the lever socket. In the first position the pawl will raise the load in the usual manner. The second position is neutral. The third position is used for running the standard down without load.

A turn of the thumb-screw "1" applies the brake when lowering the jack and holds up the load, no dependence being placed upon springs. A positive stop at the base of the standard prevents over-extending of the jack beyond the safe limit of the raise. The closed height of the 25-ton jack is 28 in., and 43¼ in. when fully extended; it weighs 170 lbs. The 50-ton type with a 23½-in. lift weighs 290 lbs.

THE ANNUAL MEETING of the B.E.A.M.A. took place at the Connaught Rooms this morning, and was followed by a luncheon, at which the chairman, Colonel R. K. Morcom, presided.

Human Factor in the Causation of Accidents.

The Industrial Fatigue Research Board has issued a Report (No. 34), being "A Contribution to the Study of the Human Factor in the Causation of Accidents," compiled by MR. E. M. NEWBOLD, B.A., in which it is pointed out that the conditions of our present civilisation tend more and more to make it possible for an accident arising from some trivial cause to involve many in disaster.

The original aim of the investigation to which the report relates was to examine the incidence of accidents in different industries with special regard to the following points, so far as these can be determined from factory records without special experiment: (1) The possibility of establishing in different occupations a characteristic ratio between the frequency of accidents of all kinds and notifiable accidents; (2) the question of the extent of the existence of individual workers having a distinct tendency to incur accidents; (3) the statistical correlation of accident incidence with age, sex, experience, health, output, etc. The report contains a large number of tables and charts which have enabled the following conclusions to be reached:—

The reported ambulance-room accidents (whether trivial or serious) have been examined in a number of a group of factory workers covering different occupations, for periods of time varying from three months to two years. It is found that in almost all the groups the average number of accidents is much influenced by a comparatively small number of workers, and that the distributions among the workers are far from chance ones. It is not possible in a mass examination of this kind to find how much of this may be due to individual differences in the conditions of work or how much to personal tendency; but there are many indications that some part, at any rate, is due to personal tendency.

Figures are given by which a rough estimate can easily be made from the accident records of a department, whether the causes of accidents are mainly such as affect all workers alike, or whether special risk is attached to any individuals. If the latter is the case it rests in the hands of the factory officials, familiar with all the conditions of the work, to see how far the cause is mechanical or personal. The hypothesis that the occurrence of one accident makes the occurrence of others either more or less likely does not fit these observations. The particular hypothesis tested of differing initial individual susceptibility is nearer the truth, but clearly other factors come in.

There is a tendency for the number of accidents to decrease to some extent with age, and apparently also, though to a less extent, with length of service in the factory; but when allowance is made for age, there is no independent association between experience and accidents; while when allowance is made for experience, the association between accidents and age remains. A decreasing accident tendency with age towards serious accidents is shown not to be necessarily inconsistent with the known higher accident mortality and invalidity rates among older workers, but the present data do not include enough serious accidents to establish any relation between the tendencies to trivial and to serious accidents. The people who have the most accidents are, on the whole, those who pay most visits to the ambulance room for minor sicknesses. The consistence of individual tendency to accident is shown by the association found between (1) accidents in two different periods, (2) accidents of one type and accidents of other types, and (3) accidents in the factory and accidents at home. No consistent relation is shown between accidents and output in the few cases where output records were available. The above tendencies are shown by men and women alike.

The indications of individual differences seem to be definite enough to justify further more detailed investigation on the lines of individual study and experimental psychology which is now being carried on, rather than on the lines of the present report. The present results show that it is clearly necessary in such study to take age and health into consideration.

Gases Evolved from Heated Iron.*

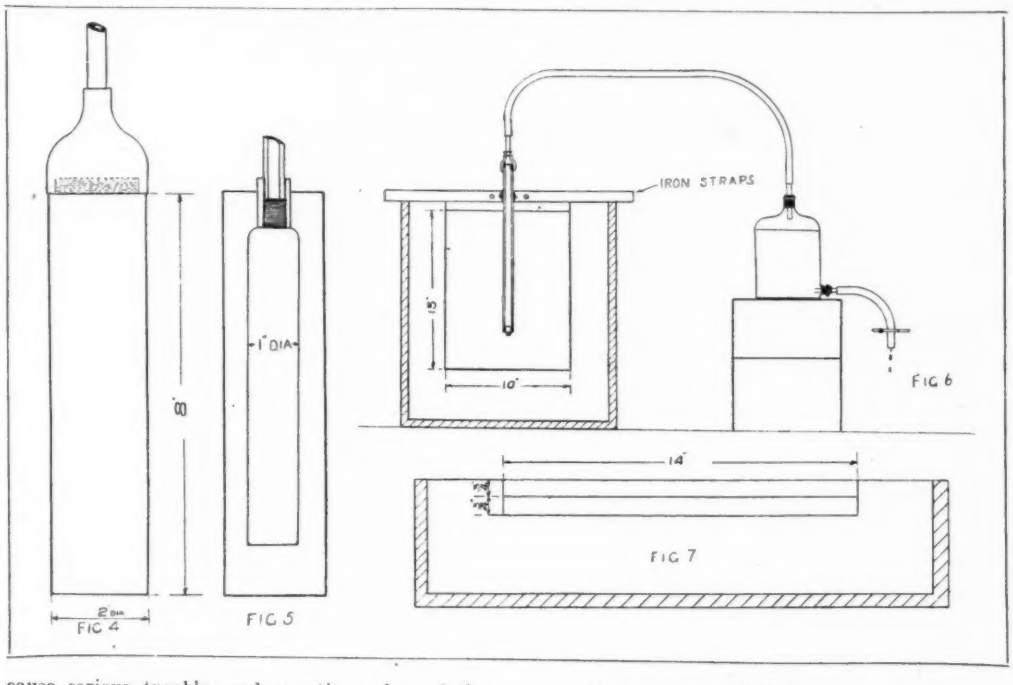
By Ben Hird.

In the following experiments an attempt was made to discover the nature of the gas which is given off from solid pieces of iron when their temperature is raised. This frequently occurs when nails, studs, chaplets, pieces of bar or pipe, chills or denseners are placed in moulds, and

FIGS. 1 TO 3.

their temperature raised by pouring molten iron around them. The gases given off under these conditions form gas holes in the vicinity, or directly connected with the nails, etc., which often cause serious trouble, and sometimes, loss of the casting when they occur on machined faces, or, where pressure tests are required. Figs. 1 to 3 show blowholes caused by gas given off from a clean 6-in. sprig (Fig. 1); a tinned stud (Fig 2); and a tinned pipe nail (Fig 3). These were cast open in green-sand experimental moulds 2 in. × 3 in. × 6in. long, four in each mould. When the castings were broken, all the sprigs and pipe nails showed blowholes, of the studs, two were solid and two were blown.

The first experiment was carried out as shown in Fig. 6. A mould was made in green sand from a pattern 10 in. dia. by 13 in. long and left open at the top. A piece of 1 in. wrought-iron pipe 5/16 in. thick in section, sealed at one end and screwed at the other to take a reducing socket into which a short piece of ¼-in. pipe could be fixed was made. The pipe was ground up bright on an emery to remove all traces of oxide, and afterwards heated to redness in a flame to remove all moisture, then allowed to cool (*circa* 80 deg.C.). When the mould was filled with molten iron, the pipe was pushed down in the centre and held there by weights on the iron straps, which were clipped on to the pipe and took a bearing on the edge of the moulding box. A length of rubber tube connected at one end to a 500 cc. gas-collecting bottle was pushed over the ¼-in. pipe. Gas began to come through at once; after four minutes it came very freely in pulses of four to five seconds intervals. The bottle was filled with gas in twelve minutes, and a second 500 cc. bottle was connected up. The gas now came more regularly, this bottle was filled in 28½ minutes, making a total of 1,000 cc. of gas in 30½ minutes. The rubber pipe was disconnected and a light applied to the end of the ¼-in. pipe; gas was still coming off and ignited for an instant with a pale blue flame. Looking down the tube it was possible to discern about 1 in. from the top of the casting a number of small bubbles, seeming that the gas was forcing its way through the pipe at this point. Next day, when the casting was broken, the top portion, close to the pipe, where the small bubbles were seen, was honeycombed all around with blowholes, for a depth of 2 in. Large gas holes extended from the pipe into the casting in many directions (Fig. 8).



Experiment with Hollow Cast-Iron Chills.

A second experiment was made with cast-iron chills (or tubes) on similar lines to the first. Four cast-iron chills were made 2 in. dia. by 8 in. long with a 1 in. hole in the centre, one end solid and a ¼-in. gas union cast in the other to take the piece of ¼-in. pipe, as shown in Fig. 5. The chills were quite free from rust or moisture and were heated to 200 deg. C. before casting the iron around them. Several countersinks were put in each chill, the object being to assist the gases to penetrate to the centre hole. Each mould was 10 in. deep and the chill was set in the centre just before pouring the iron.

No. 1, 4½ *in. Diameter.*—Hot iron was poured into the mould and gas was evolved at once with a very quick flow, easing off to very slow after two minutes. Forty-five minutes later there was a sudden increase in the flow for about two minutes. The 500 cc. bottle was filled in 85

* A Paper read before the Wales and Monmouth Branch of the Institute of British Foundrymen, Mr. P. L. Gould presiding.

minutes. This casting was quite solid when broken, as shown in Fig. 9 (1).

No. 2, 6 *in. Diameter.*—Hot iron was again poured into the mould; gas came off quickly at once, easing off after one and a half minutes; from then on it came away very slowly. The 500 cc. bottle was filled in 82 minutes. This casting was quite solid when broken, as shown in Fig. 9 (2).

No. 3, 8 *in. Diameter.*—Once more hot iron was poured into the mould; gas came off at once very quickly; it reached maximum in one and a half minutes and could be seen coming into the bottle like a thin white mist. The gas continued to evolve freely, the 500 cc. bottle being filled in eleven minutes. Gas was still coming away after

Fig. 8.

disconnecting the bottle. When this casting was broken large blowholes were found, which showed distinct proof of coming from the chill, as shown in Fig. 9 (3).

No. 4, 10 *in. Diameter.*—This time dull iron was poured into the mould; the gas came off very slow at first, but after two minutes it came more freely, gradually increasing. About 400 cc. of

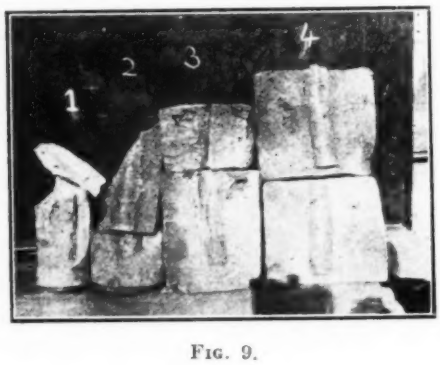


Fig. 9.

gas was collected in 48 minutes when the flow ceased. This casting was quite solid when broken, as shown in Fig. 9 (4).

The condition of the chills when the moulds were burst open was quite sound and perfect, showing no signs of seizing on or distortion.

Experiment with Solid Cast-Iron Chills.

The chills were made as shown in Fig. 4, that is 2 in. dia. × 8 in. long. Three moulds were made 10 in. long × 6 in., 8 in. and 10 in. dia. respectively. They were all cast with hot iron and the chills were warmed to 100 deg. C. before placing them in the moulds.

No. 2, 6 *in. Diameter Mould.*—Gas came as soon as the mould was filled with iron, the flow was very slow. There was a distinctly noticeable increase in the flow of gas about 30 minutes after casting, which lasted for about ten minutes; about 200 cc. of gas was collected in 77 minutes.

No. 3, 8 *in. Diameter Mould.*—When the mould was filled gas came at once very quickly; about 200 cc. of gas was collected in eight minutes, the 500 cc. bottle was filled with gas in 45 minutes.

No. 4, 10 *in. Diameter Mould.*—Gas came off at once very quickly and could be seen gathering in the top of the bottle like a thin white mist. The water flowed from the outlet tube in a steady stream for thirteen minutes, then eased off to 115 drops per minute. The bottle was filled with gas in 20 minutes.

When these castings were burst open, the chills showed a peculiar distortion, varying in intensity with the diameter of the castings as can be seen in Fig. 10. No. 2 (Fig. 10) was very slightly distorted; No. 3, more so; whilst No. 4 was quite pronounced. When the chill was broken out of No. 4 the hole formed by the chill was pressed back behind where the distortion to the chill is seen in the illustration and a crack about 1½ in. long ran back into the casting. When the portion was broken through,

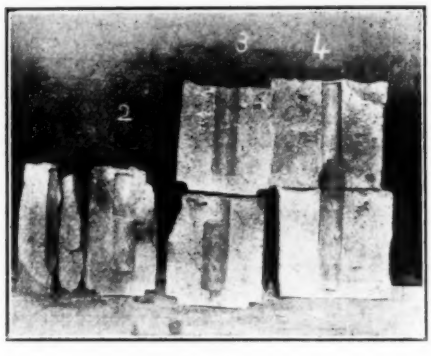


Fig. 10.

a large cavity extending a considerable distance was disclosed, a portion of this being shown in Fig. 11 (1). A part of the same cavity can be seen in the left-hand corner of the top half and right-hand corner of the bottom half of Fig. 10 (4). Apart from this the holes formed by the chills were quite true to shape. The appearance of the chills suggested that some extremely high pressure

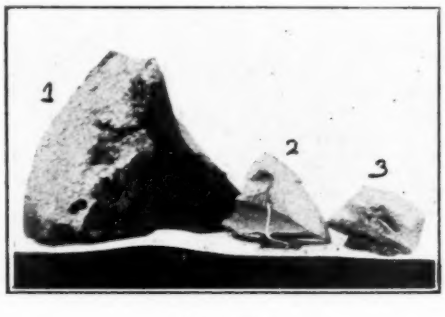


Fig. 11.

had been exerted upon them whilst in a semi-molten state. The fact of the holes formed by the chills being quite true and smooth suggests that this distortion was caused by the gas pressure. Fig. 12 shows the condition of the sides of the hole very clearly, also the method of collecting the gas.

When broken, No. 2 showed a characteristic pipe opening up into larger cavities where the gas, reaching the more liquid metal in the centre of the section, has more freedom to expand. This is shown more clearly in Fig. 11 (2 and 3). A piece of string and a piece of wire were placed in one of the many pipe holes to emphasise this point, which the author has often noticed when gases have been given off from solid metals inserted in moulds, whether in the form of chills or to be cast-in. A personal theory is that the gases are given off from the solid iron, after it has been raised to a certain temperature by the surrounding

molten metal, the metal around the chill having solidified to a soft, putty state before the gas is given off, so that the gas has to force its way forming small pipes or channels to where the metal is more liquid. Here the gas has room to expand, and forms larger cavities. The casting shown in Fig. 11 (3) had several similar blowholes, but the piping was not quite so pronounced.

There is here a phenomenon which is very difficult to explain. The chill in the smaller diameter casting is the least distorted, and the gas has penetrated into the casting, obviously whilst it was in a plastic condition. The chill in No. 3 has more distortion and less evidence of pipe-shaped blowholes. The chill in No. 4 is badly distorted, and there is only one distinct gas hole leading from the chill which had the appearance of being caused by an intense pressure of gas bursting through the almost-solidified metal surrounding the chill. One would have expected the opposite to occur, and the larger diameter casting to be penetrated by the pipe-like holes if the outlined theory is correct. It is not desired to advance any dogmatic conclusions, but merely to state, as clearly as possible, the results of the experiments made in the hope that others will take up this question which is so important to foundrymen.

From these experiments and past experience it is recommended that all who use round chills of

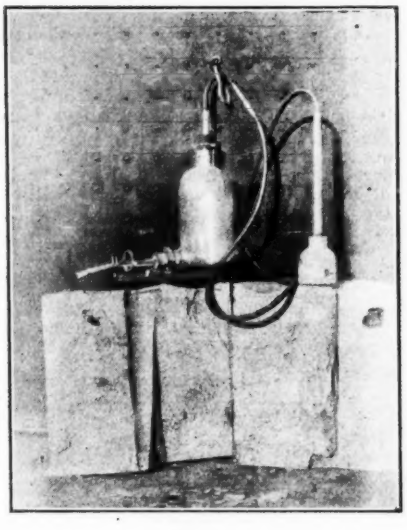


FIG. 12.

this type provide them with a hole through the centre, like a vent, to give the gases a means of escape.

Heating Chills in a Coke Fire.

The chill was of the same type as used in the previous experiments with solid chills, that is to say, 2 ins. dia. × 8 ins. long., and also was connected up to the gas bottle in the same way.

The chill was placed in the furnace fire at 3.25 p.m., and gas started to be evolved at 3.29 p.m. The bottom part of the chill was showing a dull red at 3.30, when the pressure of gas caused the water to flow from the bottle in a small, steady stream, which reached its maximum about 3.33. At 3.35 the chill was red hot about half way up, and the water from the bottle had diminished to rapid drops 120 per minute. The 500 cc. bottle was now about half-full of gas. At 3.40 the drops had further diminished to 52 per minute, and the bottle was about three-quarters full of gas. The chill was now red hot at the top and white hot at the bottom, in fact the chill had just started to melt. At 3.45 the water was coming away at the rate of ten drops per minute, and there was about half an inch more gas in the bottle. At 3.50 drops of water had almost stopped—being 5 per minute—half of the chill was now melted away. At 3.55 three drops per minute, and at 4.0 o'clock the gas had stopped coming away from the chill and the part which remained unmelted was taken out of the fire.

The gas from these experiments was tested in an Orsat Lougué gas analysis apparatus containing four tubes. The author was not able to check the results very carefully, but Table I shows the average of the results obtained.

TABLE I.—*Composition of Gases evolved in the experiments described.*

	CO_2	CO.	H_2.	O.
Experiment No. 1 Wrought iron tube	Nil.	3.3	66.0	Nil.
Hollow Chills, No. 1 ..	5.5	22.0	Nil.	15.5
,, ,, 2 ..	6.2	21.3	Nil.	12.8
,, ,, 3 ..	4.3	13.3	6.2	14.2
,, ,, 4 ..	7.6	20.1	Nil.	13.6
Solid Chills No. 2 ..	14.5	17.5	Nil.	5.0
,, ,, 3 ..	30.5	36.5	4.66	3.0
,, ,, 4 ..	9.0	12.0	Nil.	8.0
Solid chill heated in fire ..	5.0	7.5	Nil.	Nil.

As a result of another simple experiment made to prove that gases are given off from solid iron when it is at a certain temperature, it is thought that by careful research the exact temperature could be found. In this case two open sand-moulds were made as shown in Fig. 7. Iron was poured in to a thickness of three-quarters of an inch into each of the moulds. Fig. 13 (1a) illustrates a casting which was allowed to cool down to 870 deg. C. (taken with an optical pyrometer), and then plate No. 1 was poured on top of it. Gas could be seen coming up through the layer of iron and burning for an instant with a pale blue flame until the iron set. When the plates were broken apart the top plate was honeycombed with blowholes, as shown in Fig. 13 (1).

In the case of the casting illustrated in Fig. 13 (2a) the first layer was allowed to cool down to

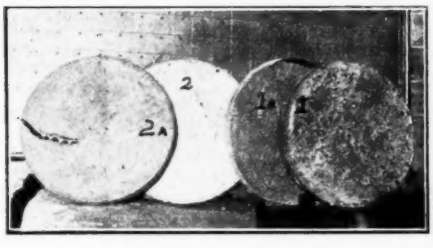


FIG. 13.

(The mark on 2A Casting is a scratch on the film.)

115 deg. C., taken with a thermometer, before pouring on the top layer. When these plates were separated after cooling the top one, Fig. 13 (2) was quite sound and free from blowholes.

It is well known amongst those who use chills for various purposes, such as chilled plough shares, rolls, etc., that when chills are over a certain temperature the molten iron will not lay quietly against the chills.

Although these experiments are rather crude and incomplete, the author is confident that further investigation of the phenomenon along the lines indicated will be of considerable value to the foundry industry.

Rating of Machinery.

The Ministry of Health has appointed a Committee consisting of the Right Hon. Edward Shortt, K.C. (chairman), Mr. A. Body, Mr. W. Craig Henderson, K.C., Mr. W. H. Patchell, and Mr. A. H. Preece, to prepare a statement, in accordance with the provisions of section 24 of the Rating and Valuation Act, 1925, setting out in detail all machinery and plant which appears to them to fall within any of the classes specified in the Third Schedule to the Act.

The secretary is Mr. A. N. Rucker, Ministry of Health, Whitehall, S.W.1.

CONSIDERABLE damage was caused by a fire which occurred last week on the premises of Edward Curran & Company, Limited, engineers, Hurman Street, Cardiff. The outbreak originated in the pattern department, and the entire building was destroyed.

Trade Talk.

CARTERS, 5, Moorgate, London, E.C.2, British agents for the Skoda Works, have removed to 6, Princes Street, E.C.2.

WALKER, CROSWELLER & COMPANY, Dane's Inn House, 265, Strand, London, W.C.2, have removed to 54-58, Queen Elizabeth Street, London, S.E.1.

BRITISH SHIPOWNERS have placed with the Ailsa Shipbuilding Company, Limited, of Troon and Ayr, an order for a single-screw steamer for coastal services.

AN AMALGAMATION OF INTERESTS has been arranged between Mirrlees, Bickerton & Day, Limited, of Stockport, and the Mirrlees Watson Company, Limited, of Glasgow.

A LIST OF ELECTRIC FURNACE installations by the A.E.G., includes one for the Sheffield works of Cammell, Laird & Company, Limited, in this case a 6-ton Fiat electric furnace.

SIR WILLIAM ARROL & COMPANY, LIMITED, Dalmarnock Ironworks, Glasgow, have a contract from the London and North-Eastern Railway for the extension of the Hawes Pier at South Queensferry at a cost of £20,000.

THE FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Glasgow, have received an order from the Houlder Line for a large refrigerator motor ship. The new vessel is to have Diesel engines of the Fairfield-Sulzer type.

MR. W. J. REES, head of the Department of Refractory Materials at the Department of Applied Science of Sheffield University, read a paper before the members of the Sheffield Foundry Trades Technical Society on foundry sands. Mr. B. Wood presided.

THE OSAKA MERCANTILE STEAMSHIP COMPANY, LIMITED, have ordered two vessels of 1,500 tons gross register, to be constructed by Mitsubishi Zosen Kaisha, at their Kobé Shipyard, each of which will be equipped with two sets of Vickers 600-h.p. Diesel engines.

THE ASCERTAINED PRICE of West Coast hematite mixed numbers for January and February is £3 15s. 5.17d., an increase compared with the previous ascertainment of 2.48d. In accordance with the agreement of October 21, 1925, the sliding scale percentage on base rates and tonnage earnings will remain unaltered at 16 per cent. The percentage on bonus earnings in the Workington area is 44¼ per cent., and in the Furness area 39¼ per cent.

COX & DANKS, LIMITED, announce that they have just raised at Scapa Flow the B.111, the fourth of the larger German destroyers sunk there. The vessel, which was found lying on its side, was of approximately 1,300 tons, and is the twenty-second destroyer to be raised. Although this does not exhaust the whole of the German destroyers to be raised, we understand that Cox & Danks, Limited, propose starting operations immediately on the cruiser "Hindenburg."

AS ALREADY ANNOUNCED by the Royal Metal Trades' Pension and Benevolent Society, H.R.H. the Prince of Wales will be present at its 78th anniversary festival, to be held at the Guildhall on June 1. The Rt. Hon. the Lord Mayor of London has consented to preside, and will this week issue an appeal to the metal trades, calling on firms and individuals engaged in this important industry to support their own trade charity. The Lord Mayor will address his appeal to 30,000 firms throughout Great Britain, and will set forth clearly its special aim and object, while indicating the various ways by which support can be given.

THE EXECUTIVE of the Central Ironmoulders' Association, in their annual report, state that, while the Association at the present time is in a very satisfactory position with regard to both membership and finance, they find occasion to deplore a lack of enthusiasm amongst the rank and file in the internal work of the Association. An increase of 767 is reported in the membership, which now stands at 7,786, while the funds at credit of the Association have risen during the year from £21,058 to £28,021. The executive also report that settlements with the Employers' Federation have been reached on the question of day moulder apprentice wages, and with regard to the method of paying bonuses to piece-workers.

IN REGARD to the Government grant to the Appleby Iron Company, Limited, Mr. W. Bestwick, managing director of Ashmore, Benson, Pease & Company, Limited, Stockton, and Mr. J. M. Rinquist, director of Head, Wrightson & Company, Limited, Thornaby, have both expressed opinions that the grant will send a number of orders to Tees-side because the Appleby Iron Company will require certain plant to complete their steel mills. As in the past they have been excellent customers of Tees-side industries, there is every reason to believe they will again place contracts there. Mr. Bestwick has indicated that his firm have already received orders to proceed with a contract which has been held up for a number of years owing to the trade depression, and which was for plant for the Appleby Company, to the value of £60,000.

Obituary.

MR. J. D. HAMILTON, a director of William Cumming & Company, Limited, died recently, aged 40.

THE RIGHT HON. ALEXANDER CARLISLE, a member of the Irish Privy Council, died on March 5. The deceased was principally associated with Belfast, where he spent his lifetime assisting to build up the business of Harland & Wolff, which firm he joined as an apprentice 55 years ago, and rose to the position of general manager and chairman, from which he retired in 1910.

MR. W. DEIGHTON, whose death occurred at Redcar on Friday last, at the age of 87, was a well-known engineer in Leeds and the North of England, and over 30 years ago founded the firm of Deighton's Patent Flue and Tube Company, Limited, of Pepper Road, Hunslet. He was born at Rotherham, and in his early days was associated with the steel trade in Workington, Barrow, etc.

Gazette.

THE LEA VALLEY ENGINEERING COMPANY (1924), LIMITED, are being wound up voluntarily, with Mr. C. Latham, 78, New Oxford Street, London, W.C.1, as liquidator.

MESSRS. E. TAYLOR and E. VAUGHAN, brassfounders, Pioneer Works, Willenhall, trading under the style of the Pioneer Castings Company, have dissolved partnership. Mr. E. Taylor will continue the business.

THE PUBLIC EXAMINATION of Mr. W. H. Potter, carrying on business at Debnam's Road, Rotherhithe New Road, London, iron and brass founder, under the style of D. J. Potter, has been fixed for March 23.

MESSRS. M. OSBORNE and J. N. WILLIAMS, brass and non-ferrous founders and merchants, Vine Foundry, Cross Street, Smethwick, trading under the style of M. A. Johnson & Son, have dissolved partnership, so far as concerns Mr. J. N. Williams, who retires.

AT STOURBRIDGE, on Tuesday, the adjourned examination in bankruptcy was held of Mr. J. B. Share, who had traded at Brierley Hill as an iron and steel merchant. The statement of affairs presented showed a deficiency of £7,007. The examination was adjourned for the debtor to prepare a statement as to dealings in scrap metal in 1921 to 1923.

Company Reports.

Cammell, Laird & Company, Limited.—Loss, £36,381; credit balance forward, £26,637.

Scottish Iron & Steel Company, Limited.—Profit, £61,673; ordinary dividend, 5 per cent.

Bruce Peebles & Company, Limited.—Profit, £58,131; ordinary dividend, 10 per cent. for year, with bonus 5 per cent., less tax.

Alley and MacLellan, Limited.—Second half-year's dividend on preference shares; no distribution on ordinary for year; depreciation, £10,317; carried forward, £12,332.

Wallsend Slipway & Engineering Company, Limited.—Profit, £15,093; brought forward, £14,741; from dividend equalisation fund, £25,000; available, £51,634; further tax-free dividend, 3½ per cent., making 6 per cent.; carry forward, £9,327.

British Insulated Cables, Limited.—Final dividend, 5 per cent. and bonus 5 per cent. on old ordinary shares, making 15 per cent. for year 1925; new shares, 5 per cent. and bonus 5 per cent.; depreciation and reserves, £408,335; carry forward, £224,000.

W. Canning & Company, Limited.—Profit, £43,296; brought forward, £6,697; available, £49,993; ordinary dividend, 10 per cent. per annum, less tax, £23,812; bonus, 6d. per share, less tax, £5,953 2s. 6d.; reserve fund, £15,000; employees' benevolent trust fund, £1,000; carry forward, £4,228.

North British Locomotive Company, Limited.—Profits, £37,100; brought in, £6,082; transferred from reserve, £50,000; available, £93,182; interim dividend on preference shares, less tax, £15,036; final dividend on preference shares, and 5 per cent. dividend on ordinary for year, less tax; carried forward, £13,807.

Swan, Hunter & Wigham Richardson, Limited.—Profit, £199,558; brought in, £42,948; first mortgage debenture interest for year, £13,741; instalment for sinking fund account, £1,000; final distributions, 3 per cent. on cumulative preference (making 6 per cent. for year), and 4 per cent., tax free, on ordinary, making 7 per cent. for year, free of tax; carried forward, £60,599.

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Special 'F.R.D.' Coke Oven Bricks
(High Silica Quality)

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—With outputs at Tees-side furnaces fully absorbed by current consumption, mostly booked on forward contracts, Cleveland ironmasters have, so far, been unaffected by the pending crisis in the labour world, and in the prevailing conditions hold firmly to prices, while anticipations of a reduction in view of cheaper fuel costs have not yet been realised. It does not, however, follow that some early movement towards cheaper prices may not be possible, as this policy might stimulate inquiry, and fend to put works in a better position to meet outside competition now threatening from the Continent. In the meantime, export business continues slow, shipments, so far this month, being only about half the total of the tonnage, as compared with the corresponding period in February. Quotations remain as follow, with home prices 6d. per ton less:—No. 1, 73s.; No. 3 G.M.B., 70s. 6d.; No. 4 foundry, 69s. 6d.; and No. 4 forge, 68s. 6d. per ton.

The hematite position on Tees-side has developed a slightly easier tendency, the recent increase of output having considerably reduced pressure for supplies, which, at the moment, are ample for consumers' requirements. The current quotation is at 77s. for East Coast mixed numbers, but probably this figure would be shaded for a fair-sized order. On the North-West Coast Bessemer mixed numbers are still quoted at £4 2s. 6d., c.i.f. Welsh ports; £4 5s. 6d. to £4 7s. 6d. per ton, delivered at Glasgow; £4 10s. per ton, delivered at Sheffield; and £4 14s. 6d. per ton, delivered at Birmingham.

LANCASHIRE.—The unfavourable conditions above outlined have had a further adverse effect upon foundry pig business in this area, and buying has been upon a restricted scale, though prices are mainly steady. A fair degree of activity is maintained at many of the furnaces, but fresh orders have fallen off considerably. Derbyshire No. 3 rules very steady, and 76s. per ton, delivered Manchester or equal, is the average current quotation. Lincolnshire and Staffordshire irons are also well held at 76s. to 77s. Scotch is slow at 94s. to 95s. per ton, delivered local.

THE MIDLANDS.—So far as can be ascertained at present, the approaching end of the current quarter has brought little increase of activity in foundry pig buying in the district, consumers apparently being prepared to wait until that time before considering the question of further purchases. Whether they will contract ahead, or buy from hand to mouth, remains to be seen. Ruling prices are as follow:—Derbyshire No. 3 foundry, 67s. to 70s.; Staffordshire No. 3 foundry, 66s. 6d. to 67s. 6d.; Northants, No. 3 foundry, 63s. to 64s.

SCOTLAND.—The depression recently reported in the Scotch iron trade continues unabated, there having been a distinct falling off in business for the last two to three weeks, and, once again, traders are faced with disappointment and anxiety. With such conditions prices are unchanged on the basis of 76s. 6d. for No. 3 foundry Scotch iron at furnaces, but buyers are disinclined to come into the market, although they are taking deliveries fairly well against old purchases.

Finished Iron.

In this department of the industry reports continue unsatisfactory, most of the mills being short of orders and anxious for further business, while there has never been more competition than at present. There is very little support coming from the nut and bolt works for iron, for which the price is £10 5s. to £10 7s. 6d. delivered. Most of the supplies coming into the bolt works emanate from the Continent almost solely on account of price, as the Belgian iron can be obtained at nearly £4 per ton cheaper than the local product. The improvement in the demand for iron tube strip is maintained, but prices are unaltered at a basis of about £12 10s. per ton. Marked bar quotations are unaltered at £14 per ton at makers' works; there has been a little improvement in the way of fresh business during the last week, but nothing representing any heavy tonnage. There has been no further alteration in the price of crown bars, the figure varying from £11 to £11 10s. per ton. The Staffs. works are trying to adhere to this latter figure, but are having to shade the price because of the competition from Derbyshire and Lancashire houses.

Steel.

In the Sheffield market for semi-products acid billet business is inclined to weaken to some extent, although, on the whole, a good tonnage is being dealt in. The slackening in Continental competition in basic billets has recently helped makers at home, who have cut prices to the bone to tempt buyers. The amount of buying is now less, users showing an extremely cautious attitude. Steel hoops are a fair market at an unchanged price. Steel exports are fairly well maintained. Crucible steel makers report a falling off in business, but there is a good deal of activity in another section of steel manufacture. Although business in tinplates is not of a substantial character, inquiries from overseas are broadening, and the Far East, South Africa, and the Continent are in the market; Spain and Portugal, France, and Italy are amongst the Continental buyers. Prices are steady, and makers are hoping for improved conditions, with the output restriction scheme in operation.

Scrap.

Very little improvement all round can be reported in current demand for this class of material, although in Scotland a fair average tonnage of foundry scrap has been disposed of recently. At Glasgow heavy machinery cast-iron scrap in pieces not exceeding 1 cwt. has been sold at 74s. to 75s. per ton. Ordinary cast-iron scrap to the same specification remains unchanged at 68s. to 70s. per ton, and for old cast-iron railway chairs 73s. 6d. to 74s. 6d. per ton. Light cast-iron and firebars are also unchanged at 61s. to 62s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works. In Lancashire textile machinery cast-iron scrap is a shade lower at round 75s. per ton, and ordinary machinery scrap at about 70s., these prices being for delivery to buyers' works.

Metals.

Copper.—At the moment the depression prevailing in this section of the metal markets continues unrelieved, with quotations for standard again tending to still lower levels. In addition the metal has come under the influence of the conditions existing in other commodities, and prices gave way more for lack of buying interest than by reason of any particular pressure to sell. Therefore, the market in the meantime is left very poorly supported, and its sagging tendency is against any broadening of new interest on the part of consumers. Current quotations:—*Cash*: Thursday, £58 17s. 6d.; Friday, £58 15s.; Monday, £59; Tuesday, £59 2s. 6d.; Wednesday, £59 5s.

Three Months: Thursday, £59 17s. 6d.; Friday, £59 15s.; Monday, £60; Tuesday, £60; Wednesday, £60 5s.

Tin.—Values of standard tin fully maintain recent strength, and while occasionally bear pressure secures the upper hand, and thereby causes a reaction in prices, such conditions are only of a temporary character, and values rapidly recover, and usually peg a slightly higher position in the movement to the £300 level. The main feature is that the statistical position is intrinsically sound, and with the visible supply at the end of February down to the smallest amount for years, totalling at only 15,100 tons, there is no likelihood of any serious set-back from the present level of values. Current quotations:—*Cash*: Thursday, £295 5s.; Friday, £295 15s.; Monday, £295 5s.; Tuesday, £297 12s. 6d.; Wednesday, £299.

Three Months: Thursday, £286 10s.; Friday, £287 5s.; Monday, £287 5s.; Tuesday, £288 15s.; Wednesday, £289 7s. 6d.

Spelter.—Conditions in the market for zinc continue unsatisfactory, and under persistent liquidation values have given way, while the decline in the American price has not helped the market. Unfortunately for the bull element, there is still an ample supply coming forward from the Continent so that the immediate outlook is in favour of buyers. Prompt metal has been obtained for some little time past at a small discount. Current quotations:—*Ordinary*: Thursday, £34 6s. 3d.; Friday, £33 17s. 6d.; Monday, £33 15s.; Tuesday, £33 15s.; Wednesday, £33 17s. 6d.

Lead. — With fluctuation usually confined within narrow margins, the market for soft foreign pig has steadily drifted to a lower level, with a pronounced easiness in the near position, owing to the heavy surplus which has been weighing on the market for some time. Some rain has been reported in Australia, but apparently it is not sufficient for the requirements of the mines, where the shortage of water is serious. To a small extent the Government is rendering some assistance. Current quotations:—*Soft foreign (prompt)*: Thursday, £31 10s.; Friday, £31 11s. 3d.; Monday, £31 17s. 6d.; Tuesday, £31 18s. 9d.; Wednesday, £32 7s. 6d.

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Coal Dust, Charcoal, Plumbago, and Black Lead Core Gums, and all Foundry Requisites.

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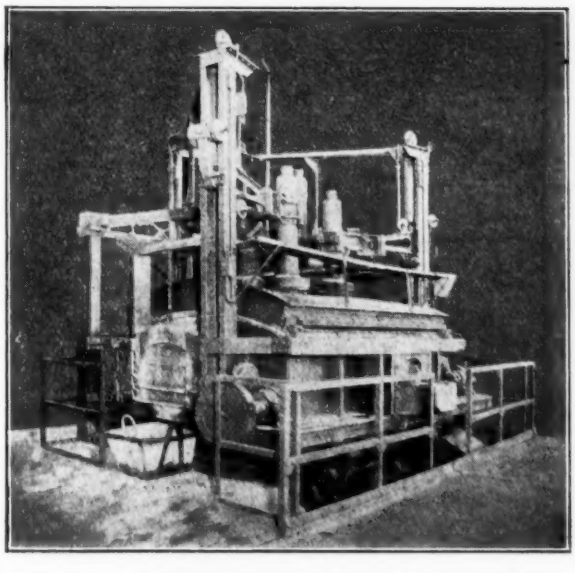

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CONTRACTORS TO HOME AND FOREIGN GOVERNMENTS.

WATSONS (METALLURGISTS) LIMITED

Lancaster Street, SHEFFIELD

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	59	5	0
Three months	60	5	0
Electrolytic	66	5	0
Tough	61	15	0
Best selected	62	10	0
Sheets	90	0	0
India	75	0	0
Wire bars	66	5	0
Do. March	66	0	0
Do. April	66	0	0
Ingot bars	66	0	0
H.C. wire rods	70	5	0
Off. av. cash, Feb.	59	14	7¼
Do., 3 mths. Feb.	60	14	8¼
Do., Sttlmnt, Feb.	59	14	1½
Do., Electro, Feb.	66	12	6
Do., B.S., Feb.	64	0	0
Aver. spot price copper, Feb.	59	14	1½
Do., wire bars, Feb.	66	17	6
Solid drawn tubes		13d.	
Brazed tubes		13d.	
Wire		10d.	

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	299	0	0
Three months	289	7	6
English	298	0	0
Bars	298	5	0
Straits	297	17	6
Australian	298	2	6
Eastern	288	5	0
Banca	297	17	6
Off.aver. cash, Feb.	287	4	9
Do., 3 mths., Feb.	280	4	4½
Do., Sttlmt. Feb.	287	3	6
Aver. spot., Feb.	287	3	6

SPELTER.

	£	s.	d.
Ordinary	33	17	6
Remelted	33	17	6
Hard	28	5	0
Electro 99.9	37	12	6
English	34	7	6
India	30	15	0
Zinc dust	43	0	0
Zinc ashes	15	0	0
Off. aver., Feb.	36	0	1¼
Aver., spot, Feb.	36	1	0¾

LEAD.

	£	s.	d.
Soft foreign ppt.	32	7	6
English	33	10	0
Off. average, Feb.	33	18	0¾
Average spot, Feb.	33	18	0¾

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	43	0	0
Do. V.M. ex whf.	41	0	0
Rods	47	0	0
Boiler plates	40	10	0
Battery plates	40	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	99	0	0
Chinese	85	0	0
Crude	46	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	14	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	£9 10 0
45/50%	£11 14 0
75%	£20 12 6
Ferro-vanadium—	
35/40%	14/5 lb. va.
Ferro-molybdenum—	
70/75% c. free	6/– lb.
Ferro-titanium—	
23/25% carbonless	11½d. lb.
Ferro-phosphorus, 20/25%,	£17 0 0
Ferro-tungsten—	
80/85%,c.fr.	1/9½ lb.
Tungsten metal powder—	
98/99%	2/1 lb.
Ferro-chrome—	
2/4% car.	£35 0 0
4/6% car.	£22 17 6
6/8% car.	£21 15 0
8/10% car.	£20 17 6
Ferro-chrome—	
Max. 2% car.	£39 5 0
Max. 1% car.	£44 10 0
Max.0.70%car.	£55 10 0
70%,carbonless	1/5½ lb.
Nickel—99% cubes or pellets	£170
Cobalt metal—98/99%	10/– lb.
Aluminium 98/99%	£112
Metallic Chromium—	
96/98%	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 10 0
76/80%, packed	£16 10 0
76/80%, export	£15 0 0
Metallic manganese—	
94/96%, carbonless	2/– lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over	4d.lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼in. to $\frac{1}{16}$ in.	1/– lb.
Flats, ½in. × ¼in. to under 1 in. × ⅜ in.	3d. lb.
Do. under ½in. × ¼in.	1/– lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/s steel makers' work

SCRAP.

	£	s.	d.	£	s.	d.
South Wales—						
Hvy. steel	3	8	6 to	3	12	6
Bundled steel & shrngs.	3	3	6 to	3	7	6
Mixed iron & steel	3	2	6 to	3	5	0
Heavy cast iron	3	2	6 to	3	6	0
Good machinery for foundries	3	7	6 to	3	10	0
Cleveland—						
Heavy steel		3	4	6		
Steel turnings		2	7	6		
Cast iron borings		2	5	0		
Heavy forge		4	5	0		
Bushelled scrap		3	10	0		
Cast-iron scrap		3	5	6		
Lancashire—						
Cast-iron scrap	3	10	to	3	15	0
Heavy wrought	3	10	to	3	15	0
Steel turnings		2	0	0		
London — Merchants' buying prices delivered yard.						
Copper (clean)		50	0	0		
Brass (clean)		39	0	0		
Lead (less usual draft)		28	0	0		
Tea lead		24	0	0		
Zinc		23	0	0		
New aluminium cuttings		85	0	0		
Braziery copper		45	0	0		
Gunmetal		46	0	0		
Hollow pewter		190	0	0		
Shaped black pewter		144	0	0		

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1	72/6
Foundry No. 3	70/–
Foundry No. 4	69/–
Forge No. 4	68/–
Hematite No. 1	77/6
Hematite M/Nos.	77/–
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/6
,, d/d Birm.	94/6
Midlands—	
Staffs common*	—
,, No. 4 forge	62/6
,, No. 3 foundry	67/–
Shrops. basic	70/–
,, Cold blast, ord.*	185/–
,, ,, roll iron*	190/–
* d/d Birmingham.	
Northants forge	57/–
,, fdry No. 3	63/6
Derbyshire forge	62/–
,, fdry. No. 3	68/6
,, basic	65/–
Scotland—	
Foundry No. 1	81/6
,, No. 3	76/6
Hem. M/Nos.	76/6
Sheffield (d/d district)—	
Derby forge	66/–
,, fdry. No. 3	72/–
Lincs. forge	67/6
,, fdry. No. 3	70/–
E.C. hematite	87/6
W.C. hematite	90/–
Lincs. (at furnaces)—	
Forge No. 4	61/6
Foundry No. 3	64/–
Basic	64/–
Lancashire (d/d eq. Man.)—	
Derby forge	69/6
,, fdry. No. 2	76/–
Northants foundry No. 3	76/3
Dalzell, No. 3	110/–
Summerlee, No. 3	94/–
Glengarnock, No. 3	94/–
Gartsherrie, No. 3	94/–
Monkland No. 3	94/–
Coltness, No. 3	94/–
Shotts, No. 3	94/–

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	0	0 to	12	0	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt	10	5	0 to	10	7	6
Hoops	14	0	0 to	15	0	0
Marked bars (Staffs.) f.o.t.				14	0	0
Gas strip				12	10	0
Bolts and nuts ⅜ in. × 4 in.				16	15	0
Steel—						
Ship plates	7	7	6 to	7	17	6
Boiler plts.				11	10	0
Chequer plts.				9	15	0
Angles	£7	0	0 to	7	5	0
Tees	£8	0	0 to	8	5	0
Joists	£7	0	0 to	7	5	0
Rounds and Squares 3 in. to 5½ ins.				8	0	0
Rounds under 3 in. to ⅜ in.				7	15	0
Flats, over 5 in. wide and up				8	10	0
Flats, 5in. to 1½in.				7	10	0
Rails, heavy				8	0	0
Fishplates				12	0	0
Hoops (Staffs.)				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	0	0
Galv. fencing wire 8g. plain				14	0	0
Billets,soft	£6	2	6 to	6	5	0
Billets, hard				8	2	6
Sheet bars	6	0	0 to	6	2	6
Tin bars d/d	6	2	6 to	6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.76
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	22.76
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.22
Steel bars	2.00
Tank plates	1.85
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.50
Sheets, black, No. 28	3.25
Sheets, galv., No. 28	4.50
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	32/6 to 37/6
,, furnace	20/– to 25/–
Durham & North.	
,, foundry	30/– to 33/–
,, furnace	15/– to 15/6
Other Districts, foundry	30/– to 33/–
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/4½
,,	28×20, ,,	38/9
,,	20×10, ,,	29/1½
,,	18¾×14, ,,	20/4½
C.W.	20×14, ,,	17/7½
,,	28×20, ,,	35/1½
,,	20×10, ,,	24/1½
,,	18¾×14, ,,	18/4½

Terneplates 28×20, 35/9 per box basis f.o.b.

SWEDISH IRON.

Bars,hammered	£18/10 to £19/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12

Pig-iron £6 15 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.		
Mar. 11	58	17	6	dec.	2/6
,, 12	58	15	0	,,	2/6
,, 15	59	0	0	inc.	5/-
,, 16	59	2	6	,,	2/6
,, 17	59	5	0	,,	2/6

Electrolytic Copper.

	£	s.	d.		
Mar. 11	65	15	0	dec.	5/-
,, 12	65	15	0	No change	
,, 15	65	15	0	,, ,,	
,, 16	66	0	0	inc.	5/-
,, 17	66	5	0	,,	5/-

Standard Tin (Cash).

	£	s.	d.		
Mar. 11	295	5	0	inc.	58/-
,, 12	295	15	0	,,	10/-
,, 15	295	5	0	dec.	10/-
,, 16	297	12	6	inc.	47/6
,, 17	299	0	0	,,	27/6

Tin (English ingots).

	£	s.	d.		
Mar. 11	293	15	0	inc.	55/-
,, 12	294	5	0	,,	10/-
,, 15	294	0	0	dec.	5/-
,, 16	296	5	0	inc.	45/-
,, 17	298	0	0	,,	35/-

Zinc Sheets (English).

	£	s.	d.		
Mar. 11	43	0	0	No change	
,, 12	43	0	0	,, ,,	
,, 15	43	0	0	,, ,,	
,, 16	43	0	0	,, ,,	
,, 17	43	0	0	,, ,,	

Spelter (ordinary).

	£	s.	d.		
Mar. 11	34	6	3	dec.	5/-
,, 12	33	17	6	,,	8/9
,, 15	33	15	0	,,	2/6
,, 16	33	15	0	No change	
,, 17	33	17	6	inc.	2/6

Lead (English).

	£	s.	d.		
Mar. 11	32	15	0	dec.	5/-
,, 12	32	15	0	No change	
,, 15	33	0	0	inc.	5/-
,, 16	33	5	0	,,	5/-
,, 17	33	10	0	,,	5/-

BRITISH MONTHLY OUTPUT OF STEEL CASTINGS IN 1,000's OF TONS.

	1925.	1924.	1923.	1922.	1921.	1920.
January	13.3	12.7	9.9	6.2	15.1	—
February	14.0	16.0	11.6	7.0	15.5	17.0
March	13.6	16.1	13.6	7.4	14.2	19.0
April	12.4	14.6	12.6	4.9	6.4	17.0
May	13.7	16.6	14.3	3.6	2.2	18.0
June	11.5	13.8	13.8	4.9	1.9	16.0
July	13.4	15.3	11.7	7.7	6.4	18.5
August	11.0	12.7	13.0	8.6	9.4	17.3
September	12.8	14.0	13.6	9.5	9.2	19.0
October	12.5	15.1	13.3	9.4	8.2	16.4
November	11.6	13.9	14.8	9.1	7.7	16.2
December	12.1	12.8	11.9	7.9	7.2	18.0

AVERAGE MONTHLY PRICES OF FERRO-MANGANESE (80 PER CENT.)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1914	£ 9 12 0	£ 9 0 0	£ 9 0 0	£ 9 0 0	£ 9 0 0	£ 9 0 0	£ 9 0 0	£ 11 0 0	£ 12 5 0	£ 11 6 3	£ 10 7 6	£ 10 7 6	£ 9 10 8½
1915	11 0 6	12 10 0	14 10 0	15 0 0	17 15 0	20 0 0	20 0 0	20 0 0	20 0 0	20 0 0	20 0 0	20 0 0	17 11 3½
1916	20 0 0	22 10 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	52 0 0	25 0 0	25 0 0	25 0 0	23 10 10
1917	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0
1918	25 0 0	26 10 0	25 0 0	*	*	*	*	*	*	*	*	*	25 10 0
1919	*	*	*	*	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	24 10 0	23 0 0	25 10 0	24 14 3
1920	27 18 0	30 0 0	31 17 6	35 0 0	37 0 0	37 0 0	37 0 0	37 0 0	37 0 0	37 0 0	36 10 0	33 16 0	34 15 1½
1921	31 0 0	27 5 0	23 12 6	21 18 0	21 0 0	18 0 0	18 0 0	17 2 0	16 0 0	15 6 0	15 0 0	20 3 1½	
1922	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0
1923	15 0 0	15 0 0	16 0 0	17 5 0	18 0 0	18 0 0	18 0 0	18 0 0	18 0 0	17 15 0	17 0 0	17 1 8	
1924	17 0 0	17 0 0	17 0 0	17 0 0	17 0 0	17 0 0	16 10 0	14 10 0	13 10 0	13 10 0	14 3 4	14 15 0	15 14 10½
1925	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 9	15 10 0	15 10 0
1926	15 10 0	15 10 0	—	—	—	—	—	—	—	—	—	—	—

* Not quoted.

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18, BENNETTS HILL, BIRMINGHAM.
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EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

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OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
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FOUNDRY FOREMAN, recently returned from South America, desires similar position in England or abroad.—For further particulars, Box 662, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRYMAN, having first-class experience in Ironfounding, and 5 years in business for self, desires position as Foreman or Manager; knows what to expect from a foundry of to-day; able to build up business, and prepared to accept position in England or abroad; age 32; I.B.F. man.—Apply, Box 638, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MIDLAND FOUNDRY.—Enterprising young man wanted take charge; good practical experience essential; technical knowledge a recommendation; excellent prospects.—Full particulars, training and experience to Box 660, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

IRON MOULDER seeks job any part of England; light or heavy; loam or sand; willing to work on bonus.—Box 664, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MOULDER, with expert knowledge of Machine Moulding and Metal Mixing, desires post as Foreman; good organiser.—Box 666, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOREMAN MOULDER wanted for Iron Foundry dealing with medium and heavy castings; must be a practical moulder and able to fix piece-work rates.—Write, stating age, fullest details of experience and wage required, Box 650, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

REPRESENTATIVE required in Irish Free State and Ulster for sale of pig-iron on commission basis; must be well introduced among leading foundries.—" Z.Y.520," c/o DEACON'S, Fenchurch Avenue, London, E.C.3.

AGENCIES.

METALLIC CEMENT MANUFACTURERS.

AGENTS wanted, by manufacturers of well-known brand, in one or two important centres (including North-East Coast District). Those already calling on Ironfounders and Engineers will be given preference. —Box 672, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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SMALL Foundry and Engineering Works for Sale, situated in Derbyshire, as a going concern; freehold; making speciality; splendid opportunity.—Apply, Box 668, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

MACHINERY, PLANT, &c.

HORIZONTAL STEAM-DRIVEN AIR COMPRESSOR, 14-in. steam cyl., 14-in. air, 16-in. stroke, by American Well Works Company.

SENTINEL AIR COMPRESSOR, 260 cub. ft. capacity at 100 lbs. pressure, driven by 55-h.p. motor, 500 volts.

HORIZONTAL BELT-DRIVEN AIR COMPRESSOR, 15-in. cyl., 11-in. stroke, 448 cub. ft. capacity at 70 lbs., by Robey.

BELT-DRIVEN SINGLE STAGE QUADRUPLEX AIR COMPRESSORS, by Reavell, capacity 330 cub. ft. at 80/100 lbs. pressure.

LANCASHIRE BOILER, 30 ft. x 8 ft. diam., reinsure 110 lbs. per sq. in. working pressure.

DOUBLE FURNACE ECONOMIC BOILER, 14 ft. x 8 ft., reinsure 160 lbs. pressure.

CATALOGUE (10,000 LOTS) ON APPLICATION.

THOS W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

MACHINERY.—*Continued.*

SECOND-HAND Macdonald Pneumatic Jolt-ram Turnover Moulding Machine wanted; not less than 16-in. Pattern Draw.—Write, Box 670, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ELECTRIC FURNACE for disposal, 50 cwts. capacity, complete with Transformers and full equipment; condition as new.—Further details on application to Box 646, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CUPOLA, Lloyd's Fan, Moulding Boxes, Evans' Ladles with Shanks, Minister of Transport Direction Post, Patterns with Moulding Boxes, Morgan Crucibles, Carriers, Tongs, Wire Brushes, Riddles, Ganister, Rammers, Plumbago, etc., etc.—FISHER & SWAIN, Victoria Foundry, Yeovil.

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PATENT YOUR INVENTIONS, Trade-mark your Goods. Advice, Handbook and Cons. free.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146A, Queen Victoria Street, E.C.4. 38 years' refs. 'Phone 682 Central.

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LETTERS AND FIGURES for Patterns; all sizes; Aluminium; die cast, with pins in one piece; no shellac needed; simply drive them in and they cannot come off. Send for samples and prices.—A. LAKIN & SON, Totley Rise, Sheffield.

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PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

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FOUNDRY COKE, best quality, 31s. per ton works; Seconds, 18s.; BEST FURNACE COKE, 15s.; SLACK COKE from Sixpence. TRUCKS ANY STATION.

BUCKLE COLLIERY COMPANY,
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66" **CUPOLA**, by THWAITES, drop bottom, been little used; 10 tons per hour at BLACKBURN **£150**

54" **CUPOLA**, by THWAITES, 6 tons per hour, drop bottom, spark arrester, all pipes and valves, just as new, been very little used, a bargain at SLOUGH ... **£100**

48" **CUPOLA**, by THWAITES, as above, but no spark arrester at BLACKBURN **£90**

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3 Ton THWAITES **£32**
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